

MONOCENTRIC GROWTH AND PRODUCTIVITY SPILLOVER: THE CASE OF THAILAND

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Main topics

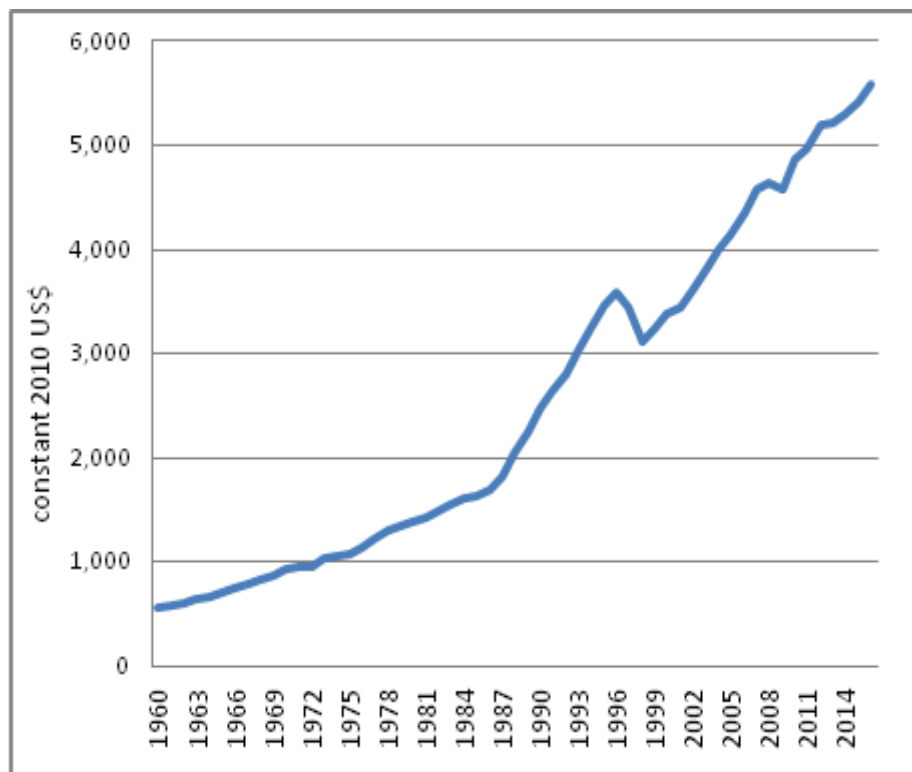
- (1) Introduction
- (2) Literature review
- (3) Methods and Data
- (4) Result analysis
- (5) Conclusion

(1) Introduction

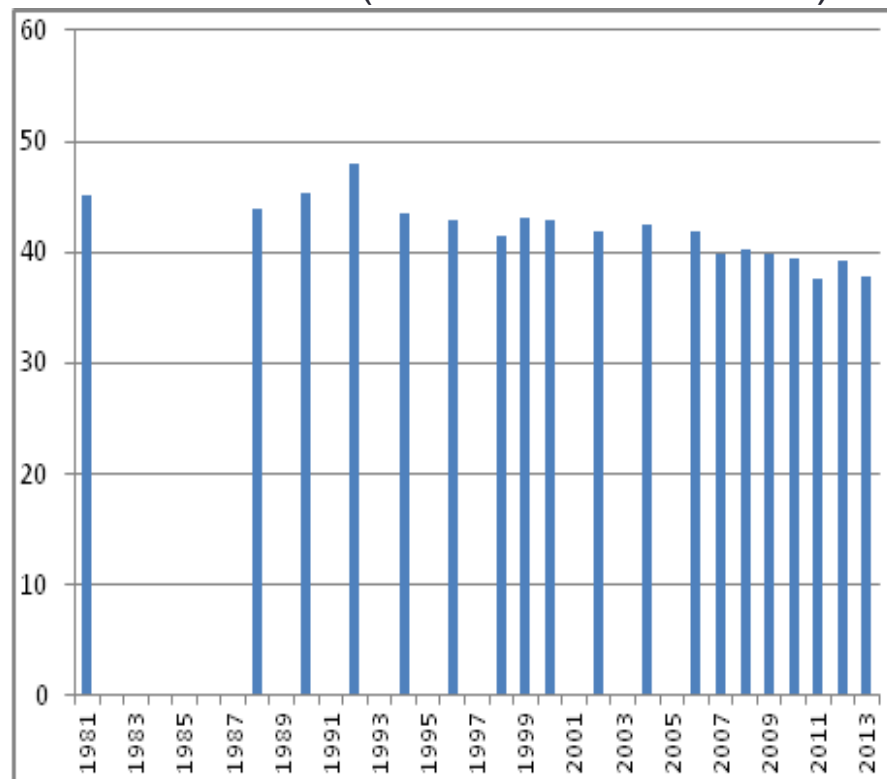
- The consecutive implementation of National Economic Development Plans has gradually transformed the economic structure through an **export-oriented strategy driven by inflows of FDI**.
- The outcome of this transformation has progressed Thailand to achieve a **GNI per capita** in **the upper-middle income category**.
- Although these macro indicators exhibit the good progress of the nation's development, there still **exists significant concern** regarding **income inequality**.

(1) Introduction (cont'd)

GNI per capita



GINI index (World Bank estimate)



Source: World Bank's World Development Indicators

(1) Introduction (cont'd)

Highest urban primacy	
Thailand	9.48
Suriname	8.24
Togo	7.92
Uruguay	7.37
Chile	5.98
Uganda	5.94
Ethiopia	5.82
Mongolia	5.67
Peru	5.43
Guinea	5.27

- The **distribution in spatial dimension** has been documented by Short & Pinet-Peralta (2009) as the **highest disproportion in the world, ranked by the urban primacy index**.
- The urban primacy index is the **ratio** of the **population** of the country's **largest city** to the combined population of the **second and the third largest cities**.

(1) Introduction (cont'd)

Research questions

- To **identify the geographical pattern of monocentric growth** by jointly using **night time light data**, **ground surveys**, and **spatial statistical techniques**.
- To quantitatively examine the **association** of **monocentric growth** and **productivity spillover** by using **spatial econometric** methodology.

(2) Literature review (cont'd)

General
Equilibrium
Model



Free mobility of
goods and all
factors of
production



A price vector equilibrating all
markets

Regional
Economic Model



Free mobility of
goods and one
factor of
production



- (1) A set of prices equilibrating
output markets
- (2) Equalization of capital –labor
ratio across regions

International
Trade Model



Free mobility of
goods



- (1) A price equilibrating goods
market
- (2) Domestic reallocation of
factors of production

Source: Fujita and Thesse (2002)

(2) Literature review (cont'd)

Perfect
Competition

Constant Return
to Scale and No
Externality

No Transportation
Cost

Isard (1949): “A wonderland of no dimensions” based on Hicks(1939) “transportation cost is implicitly contained in a production cost”

Mills (1972): “World with cities”, the economy operating under CRS and perfect competition

Ekelund and Hebert (1999): Ricardo effectively eliminated spatial considerations from his analytical system.

Romer (1992): Endogenous growth model incorporating linkage between output and tech progress

Krugman (1995): Economists understood why economic activity spreads out, not why it becomes concentrated.

(2) Literature review (cont'd)

Imperfect
Competition

Increasing Return
to Scale and
Externality

Transportation
Cost



New Economic Geography

“Centrifugal forces” vs. “Agglomeration forces”

Cities	% of land	% of population	% of GDP
Tokyo + Kanagawa + Aichi + Osaka	5.2%	33%	40%
Seoul + Kyungki	11.8%	45.3%	46.2%
Ile-de-France	2.2%	18.9%	30%

(2) Literature review (cont'd)

2.1 City agglomeration and economic growth

- Marshall (1890) indicated that the **increasing returns to the scale** of intermediate sourcing, **concentration of labor**, and the **spillover of knowledge** were the main combination of forces leading to **growth and agglomeration**.
- Jacobs (1969) extended the findings of Marshall (1890), showing that the **variety of industry and its proximity** can generate **productivity** and **growth**.
- Duranton and Puga (2004) aggregated the main findings from previous literature and **formulated a model** which integrated the influenced **economies of scale**, **labor pooling** and **knowledge spillover**.
- McCann (2008) integrated the fundamentals of Marshall and Jacobs, together with the **network of industry** and **transaction-cost** concept, and concluded that the association of **agglomeration** and **growth** was based on the integration of these factors.

(2) Literature review (cont'd)

2.2 Spatial spillover and firms' productivity

- Jaffe et al. (1993) showed that these **spillovers were localized**.
- The **proximity** of local firms to Multi-National Corporations (MNCs) can induce **absorbing technology and knowledge** through the **network of intermediate supplies** and the **turnover of workers**, as documented by Moreno & Trehan (1997), Halpern & Muraközy (2007), Crespo et al. (2009) and Lychagin et al. (2016).
- Tanaka & Hashigushi (2015), Thang et al. (2016) and Mariotti et al. (2015) have applied **GIS data** and **spatial techniques** to quantify the magnitude of **spatial spillover of productivity**, confirming the spatial externality initiated by **Multi-National Corporations (MNCs)** ultimately influencing the improvement of **local firms' productivity**.

(3) Methods and Data

(3.1) Spatial Statistics (Moran I and LISA)

- The **localized association** between **night time light** and the **main indicators** obtained from surveys has been quantitatively examined.

$$\text{Moran's } I = \frac{\sum_i \sum_j W_{ij} (X_i - \bar{X})(X_j - \bar{X})}{\sum_i \sum_j W_{ij} \sum_i (X_i - \bar{X})^2}$$

where x_i is the variable of interest, \bar{x} is the mean of x_i , N is a number of spatial unit indexed by i and j , w_{ij} is the spatial weight matrix, $(x_i - \bar{x})$ is a variation of x_i from its mean, $(x_j - \bar{x})$ is a variation of x_j from its mean.

(3) Methods and Data (cont'd)

(3.2) Theoretical background of productivity spillover

$$\ln VA = \beta_0 + \beta_1 \ln L + \beta_2 \ln K + \beta_3 \ln X$$

where

- $\ln Y$ = the vector of the national logarithm of value added
- $\ln L$ = the vector of the national logarithm of total labors
- $\ln K$ = the vector of the national logarithm of capital
- $\ln X$ = the vector of the national logarithm of controlling variables
- Specifically, the controlling variables include **the value of export, imports, FDI**, the **quality of labor** (which is based on the average schooling years), **the age of firms**, provincial **minimum wage level**, and the provincial **government expenditure**.
- The specification of the empirical test follows the conventional approach applied in most literature examining the productivity of firms.
- As introduced by Javorcik (2004), Kohpaiboon (2006), and Blalock & Gertler (2008), the trans-log form of the modified Cobb-Douglas production function is the specification of this estimation.

(3) Methods and Data (cont'd)

3.4 Ground data

- The **Official Industrial Survey of 2012**, is the main source of data for this study.
- This nationwide survey was conducted in 2012 by Thailand's National Statistical Office (NSO), collecting all the information related to production in 2011 by **98,842 firms**.
- The cleaned data was arranged in **GIS format** using **STATA** and **Quantum GIS**, generating the spatial data set indicating the provincial sum of value added, employed labor, fixed assets, export value, import value, quality of labor, average age of firm and FDI.
- Also, the provincial rate of the minimum wage, obtained from the Ministry of Labor, was included in the regression analysis.
- In 2011, the provincial minimum wage was determined by the Tripartite National Wage Committee.

(3) Methods and Data (cont'd)

(3.3) Spatial Econometric Model

(3.3.1) Spatial Lagged Model (SLM)

$$y = \rho W y + X\beta + u$$

where

$W y$ on the right-hand side of the equation represents an additional spatially lagged dependent variable

ρ is a spatial autocorrelation coefficient

$$\ln y = \rho W \ln y + \beta_1 \ln K + \beta_2 \ln L + \beta_3 \ln X + u$$

(3.3.2) Spatial Error Model (SEM)

$$y = X\beta + u \quad ; \quad u = \lambda W u + \varepsilon$$

where

The disturbance term u is a function of the neighbor's disturbance.

The endogenous u and exogenous u are the same vector, but the exogenous u is multiplied by the spatial matrix W to define the disturbance effect from the neighbor provinces. λ is the influences from neighbors.

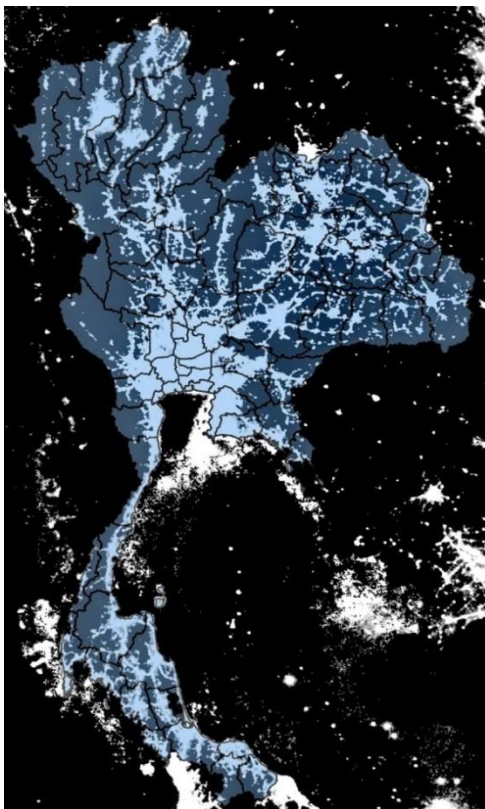
$$\ln y = \beta_1 \ln K + \beta_2 \ln L + \beta_3 \ln X + u \quad ; \quad u = \lambda W u + \varepsilon$$

(3) Methods and Data (cont'd)

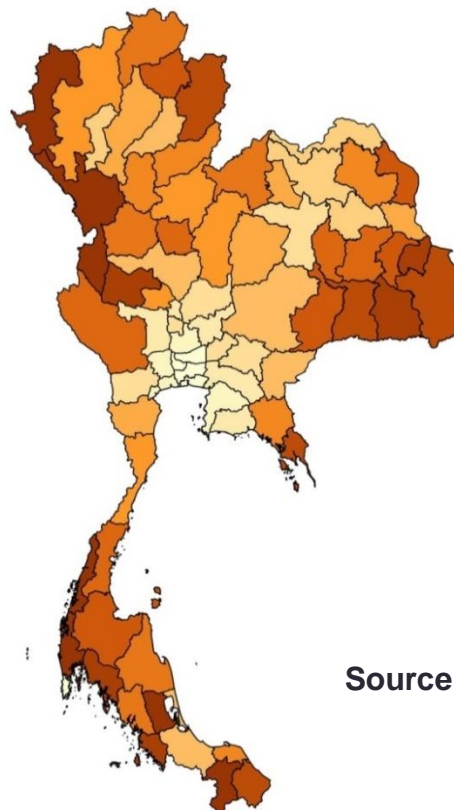
3.5 Night Time Light (NTL) data

- The **Night Time Light (NTL)** data for 2011 was originally produced by the Defense Meteorological Satellite Program/Operational Linescan System (**DMSP/OLS**), administrated by the United States Air Force.
- In this study, the NTL data has been transformed into a **provincial index**.

DMSP/OLS data for 2011



Provincial NTL index for 2011 based on DMSP/OLS data

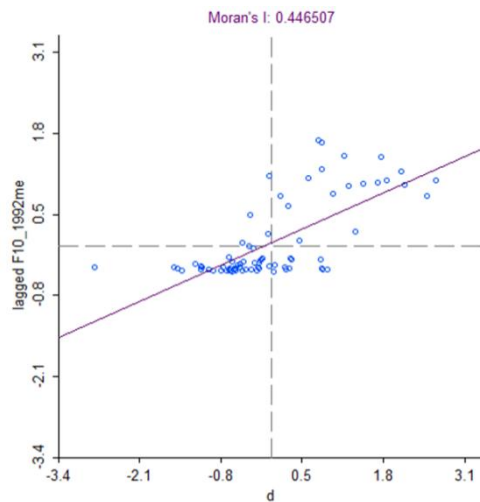


Source: Author's calculation

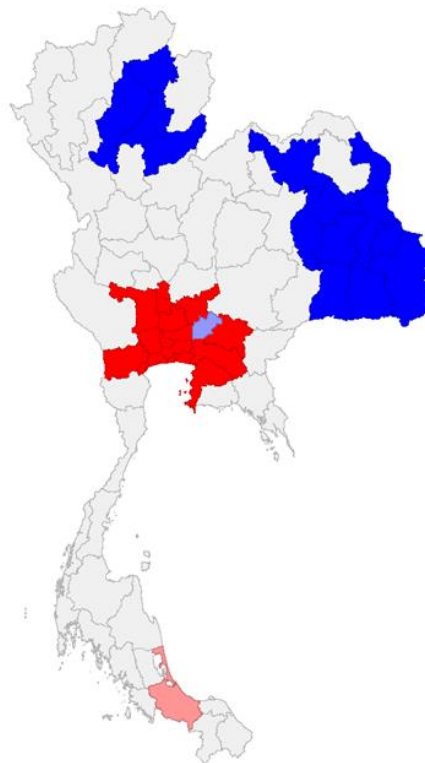
(4) Result analysis

Result of local indicators of spatial association (LISA) between **NTL** and **the industrial density**

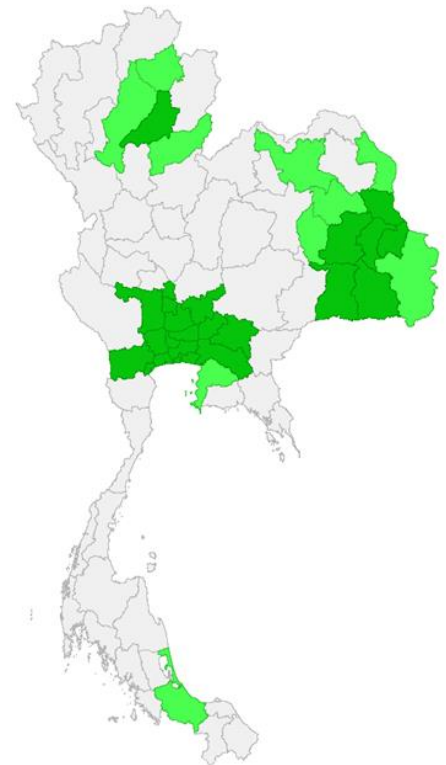
Moran Scatter Plot



Cluster map



Significance map (p value)

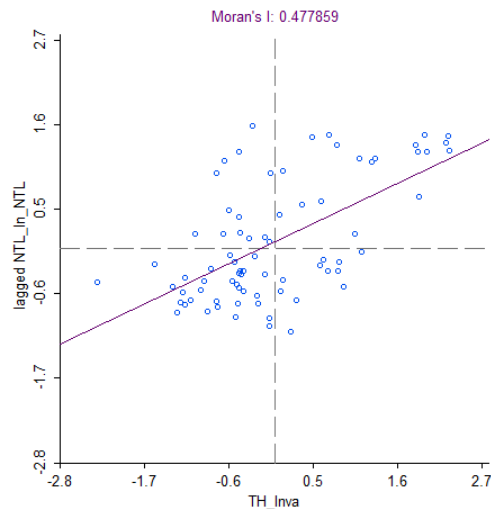


Source: Author's calculation

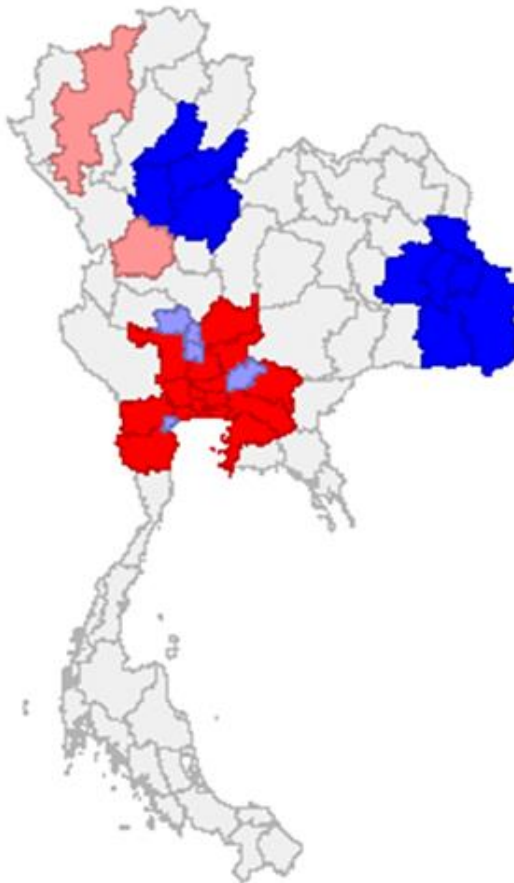
(4) Result analysis (cont'd)

Result of local indicators of spatial association (*LISA*) between **NTL** and firms' productivity

Moran Scatter Plot



Cluster map



Significance map (p value)

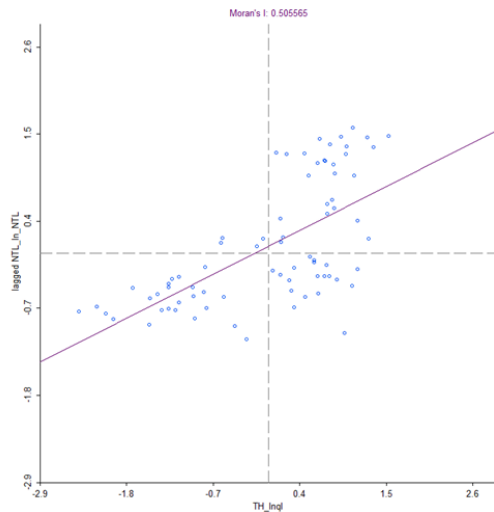


Source: Author's calculation

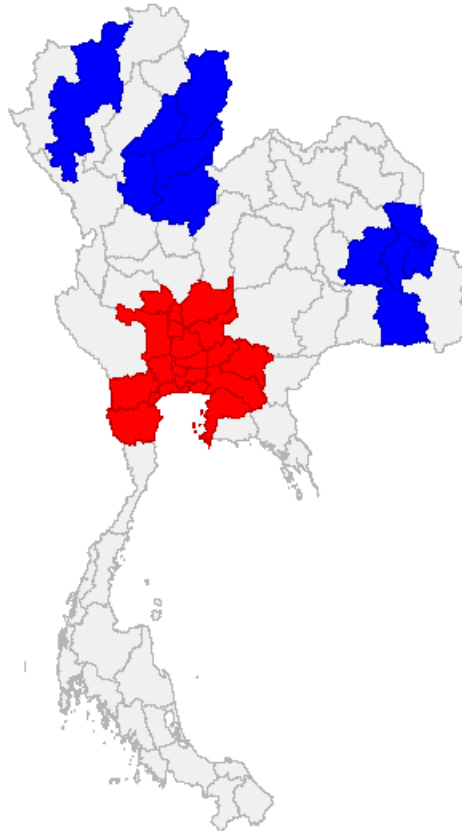
(4) Result analysis (cont'd)

Result of the local indicators of spatial association (*LISA*) between **NTL** and **labor quality**

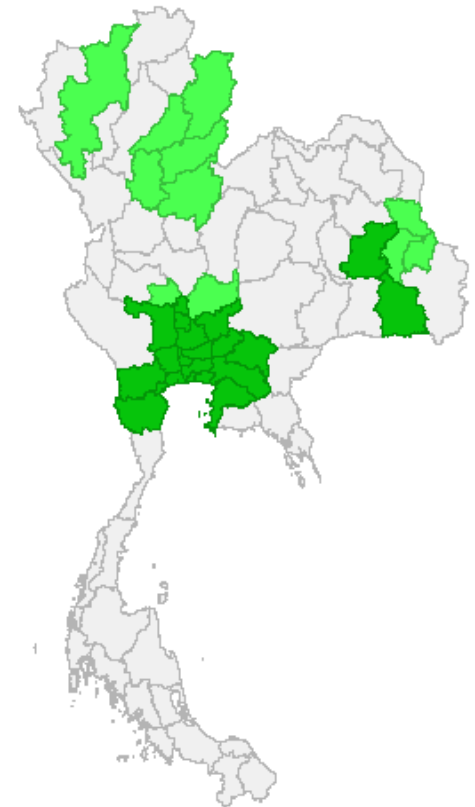
Moran Scatter Plot



Cluster map



Significance map (p value)



Source: Author's calculation

(4) Result analysis (cont'd)

LISA tests	Provinces with statistically significant associations	
	High values for both NTL and the surveyed indicator*	Low values for both NTL and the surveyed indicator**
Test #1: NTL and industrial density	Bangkok, Nonthaburi, Pathum Thani, Samut Prakan, Nakhon Pathom, Samut Sakhon, Samut Songkhram, Ayuthaya, Saraburi, Suphanburi, Angthong, Singburi, Chonburi, Chachoensao, Prachinburi, Ratchaburi	Phayao, Lampang, Phrae, Uttaradit, Kalasin, Nakhon Phanom, Mukdahan, Mahasarakham, Roi Et, Yasothon, Amnatchareon, Surin, Sisaket, Ubon Ratchathani
Test #2: NTL and firms' productivity	Bangkok, Nonthaburi, Pathum Thani, Samut Prakan, Nakhon Pathom, Samut Sakhon, Ayuthaya, Saraburi, Suphanburi, Singburi, Chonburi, Chachoensao, Prachinburi, Ratchaburi, Pethchaburi	Phrae, Uttaradit, Sukhothai, Phitsanulok, Mukdahan, Roi Et, Yasothon, Amnatchareon, Sisaket, Ubon Ratchathani
Test #3: NTL and workers' quality	Bangkok, Nonthaburi, Pathum Thani, Samut Prakan, Nakhon Pathom, Samut Sakhon, Samut Songkhram, Ayuthaya, Saraburi, Suphanburi, Angthong, Singburi, Chainat, Lopburi, Chonburi, Chachoensao, Prachinburi, Nakhonnayok, Ratchaburi, Pethchaburi	Chiang Mai, Nan, Phrae, Uttaradit, Sukhothai, Phitsanulok, Roi Et, Yasothon, Amnatchareon, Ubon Ratchathani, Mukdahan

- All the main findings obtained by the three spatial correlation tests are listed in the above table, and **these analytical outcomes** obviously **indicate the geographical pattern of monocentric growth**.
- This characteristic **affirms the agglomeration** in **the Extended BMR**, significantly attracting economic activities and **generating a substantial proportion of Thailand's GDP**.

Dependent variable is <i>ln_VA</i>	OLS	Spatial Econometric Model	
		SLM	SEM
<i>lnL</i>	0.39 (0.13)**	0.38 (0.11)***	0.42 (0.12)***
<i>lnK</i>	0.29 (0.09)***	0.25 (0.08)***	0.31 (0.08)***
<i>lnEX</i>	0.12 (0.03)***	0.13 (0.03)***	0.11 (0.03)***
<i>lnIM</i>	-0.01 (0.02)	-0.01 (0.01)	-0.01 (0.01)
<i>lnAGE</i>	-0.66 (0.47)	-0.83 (0.43)*	-0.66 (0.42)
<i>lnQL</i>	0.49 (0.15)***	0.39 (0.14)**	0.45 (0.13)***
<i>lnFDI</i>	0.27 (0.07)***	0.24 (0.07)***	0.22 (0.06)***
<i>lnMINWAGE</i>	0.18 (1.20)	-0.46 (1.11)	0.17 (1.14)
<i>lnGovtBudget</i>	-0.16 (0.26)	0.04 (0.24)	-0.09 (0.23)
Constant	12.79 (7.69)	11.70 (6.87)*	11.82 (6.93)*
ρ		0.16 (0.05)***	
λ			0.34 (0.13)**
Statistical detail			
F-stat	97.35		
R-squared	0.93		
Pseudo-R-squared		0.94	0.93
Log likelihood	-50.67	-47.68	-49.49
AIC	121.38	117.36	118.99
Moran's I	1.71*		
LM _{lag}	5.18**		
LM _{Error}	1.32		

(4) Result analysis (cont'd)

- For both the SLM and SEM, the results obtained still affirm the **positive contribution** of **labor**, **capital**, **export involvement**, **age of firms**, **FDI**, and **education of labor** on **firms' productivity**.
- However, the applicable provincial **minimum wage** and provincial **governmental expenditure do not yield** a statistically **significant impact**.
- In this study, the results of SLM and SEM affirm that there exists **a positive spatial externality** of productivity.
- In other words, the **proximity** to other high productivity firms can **increase the value-added**.
- Hence, the industrial sector and highly skilled labor **are induced to cluster within the area of the Extended BMR**.

(5) Conclusion

- **Two significant concerns** regarding the future development of Thailand.
 - (1) there is a conventional consensus among economists in the public, private, and academic sectors that the country has to progress with the development path in order **to achieve the status of high-income level**.
 - However, there is still a question regarding the appropriate development strategy, which is, will the **existing industrialization** policies for export-led growth **sustain the economic expansion over the long-term?**
 - (2) the second crucial question for the policy makers is, **will the monocentric pattern allow the country to sustain future growth?**
- If the government would like to sustain long-term growth by **establishing a second growth pole**, this study suggests that the **infrastructure and other support schemes** (e.g. tax incentives) should **generate spillover effect of at least the same magnitude as that revealed by this study**.
- Otherwise, the expansion of production and other economic activities **will continue be concentrated within the Extended BMR area**.

Thank you

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