



INDUSTRIAL DISPERSION IN THAILAND WITH CHANGES IN TRADE POLICIES

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ABSTRACT

Thailand, which is an industrial core of the GMS, hosts various industries. An understanding of current location of industry in Thailand is important in planning the future industrial network. In particular, as economic linkage within the GMS is becoming stronger, changes of industrial location with trade liberalization are an important correlation. Krugman and Elizondo (1996) provided a theoretical model for this relation. The present author conducted an empirical survey to determine whether industrial location in Thailand conforms to the Krugman and Elizondo's model. This empirical study uses data on manufacturing of gross provincial product. The proportion of manufacturing within each province, and the Herfindahl index deriving from the proportion, were used. The result is that industrial location of Thailand conforms to Krugman and Elizondo's model. During the period of import substitution, Bangkok grew to a large metropolis and gradually expanded into neighboring provinces, with escalating congestion costs. After an export oriented policy was implemented, the industries started to disperse, and some provinces became new industrial cores, with ports. In considering the extension of industries to neighboring countries, it appears that promoted investment projects, which could be leading indicators of future production, do not guarantee an increase of production in border provinces, at least in the middle term. As there is little research on this issue for Thailand, this paper will assist in identifying future industrial locations and formulating policy.

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Keywords: Industrial concentration, Industrial dispersion, Herfindahl index, Border, Import substitution policy, Export oriented policy, Thailand.

JEL Classification: F13, R12.

Contribution/ Originality

This paper contributes the first empirical study to survey whether Krugman and Elizondo's model in 1996 is applied to Thailand. The result is an important material to evaluate the impact of

trade policies to industrial location in Thailand, and it will assist in identifying future industrial locations and formulating policy.

1. INTRODUCTION

Thailand is the core of the economy in the Greater Mekong Sub-region (GMS). It has achieved longstanding economic development with industrialization. Thailand's average economic growth rates in the 1980s, 1990s, and 2000s were respectively 7.9%, 4.4%, and 4.3%. As a result, per capita income increased from 696 US dollars in 1980 to 4,992 US dollars in 2010. The manufacturing sector played an important role during this period. The proportion of the manufacturing sector in the total GDP rose from 19.6% in 1980 to a peak of 34.8% in 2003. Even in recent years it has remained around 30%.

Industrial linkage is becoming stronger in the GMS, and the production network with Thailand and neighboring countries is vital as other countries in the region have much less developed economies. In future industrial linkage in the GMS, Thailand will inevitably act as a production core in the region. Given the development of hard and soft infrastructure, the location of industries in Thailand also influences industries in neighboring countries. This is the subject of the present study.

To understand the role of industrial location, its relation to economic policies should be examined, after [Krugman and Elizondo \(1996\)](#). Trade liberalization is important to the situation in Thailand. As with other Asian economies, Thailand started industrialization with the protection of domestic production by an import substitution policy. This was followed by trade liberalization under an export oriented policy to the present day. If Krugman and Elizondo's model is applicable to Thailand, industries should have concentrated in its capital city, Bangkok, during the import substitution period. With the change of trade policy to export-oriented, industries were dispersed to border areas. This paper examines whether industrial location changed with trade liberalization, and if so, what were the Thai-specific features. The results should further the evaluation of current industrial location and provide information for future location of industries.

In the next section, theoretical and empirical studies are surveyed. Section 3 considers quantifiers of the analysis. These are applied to a case study of Thailand in section 4. Section 5 presents conclusions.

2. THEORETICAL AND EMPIRICAL STUDIES

According to Krugman and Elizondo's model, a giant metropolis, such as Mexico City, is promoted by forward and backward linkages under import substitution policies. Under a protectionist trade system using import substitution policies, forward linkage is such that the market is made in the core city, because the prices of products are lower than in peripheral regions due to saving in transportation costs. Backward linkage also emerges in the core city in relation to a supply of labor for manufacturing production. It is because the cost of commuting for workers can be saved, and as a result, firms can pay higher wages, when the production is concentrated in a large city and land rent in a large city is not so expensive. In effect, the giant metropolis is an

unintended by-product of import substitution policies. There are two ways for the role such a giant metropolis to be broken. One is by rising congestion costs with population increase. The other is, more importantly, the change in trade policies from import substitution to export oriented, involving trade liberalization. With trade liberalization, international trade costs decline. Relative to the domestic market of developing countries, the scale of the global market is much larger. Then the manufacturing center seeks foreign markets and leads industries to border areas. The giant metropolis model is broken and a new industrial region emerges.

Ades and Glaeser (1995) support the hypothesis that protection of trade policy facilitates the formation of a metropolis. Nieto (2010) examined the case of Mexico, based on a data survey.

Following the idea of Krugman and Elizondo, the model has been refined and applied in other regions. In particular, Villar (1999) extended Krugman and Elizondo's model. Villar allowed for global and local centrifugal forces. Local forces are due to commuting costs and land rent, as in Krugman and Elizondo's model. Global centrifugal force depends on the population sizes of adjacent countries, however. If the population of the neighboring country is large enough, the industrial sector will serve the neighboring country rather than domestic market, causing dispersion of industries into the border region, whereas if the population of the neighboring country is small, industries remain in the metropolis.

A further example is considered by Paluzie (2001), who studied the role of agriculture in keeping the population on the land during import substitution; this is different from Krugman and Elizondo's model. Under trade liberalization, moreover, agglomeration of industry occurs as transportation costs prove disadvantageous to industry in peripheral regions. Applied to the Spanish case, involving both industrialization and entry in the EU, Paluzie's model has explanatory power, whereas Mexico City is a giant metropolis to which Krugman and Elizondo's model is applicable.

These studies indicate that trade liberalization influences to industrial location, but the direction of centrifugal or centripetal force due to changes in trade policies is not stable if the underlying situation changes, as Paluzie (2001) states. This involves international conditions, such as the difference between North America and the EU. Mexico has a large city (Mexico City) and huge market of the United States. On the other hand, the EU has many economic cores. We should therefore observe not only each country's shift of industrial location, but also the economic conditions of neighboring countries.

In Asia, Sjöberg and Sjöholm (2004) conducted an empirical study of the spatial distribution of Indonesian manufacturing. They used the industrial establishment data of the Central Bureau of Statistics. Figures for the number in employment and the value added by province before and after trade liberalization were analyzed. Indonesia faced a deterioration in its balance of payments in 1982 due to the fall in the oil price, and began trade liberalization in 1983. The figures for 1980, 1991 and 1996 were used. Despite the substantial liberalization of trade, it was found that the concentration of the manufacturing sector did not diminish over the study period. Sjöberg and Sjöholm (2004) suggest that this is because Indonesia is an archipelago country and has a central capital, Jakarta. In contrast to a continental country such as Mexico, an archipelago country faces difficulty in developing its infrastructure to allow dispersion of the production base. Thailand

would be different again. Jakarta is considered to have played a function as Indonesia's main gateway to the rest of the world.

Chakravorty (2000) conducted a comparative study in India of industrial location before and after the economic reforms in 1991 which included trade liberalization. It was found that advanced states gained advantages from economic reform in contrast to lagged states, which is the opposite to Krugman and Elizondo's model. This is because of the size of the country. India is a very large country in which states play the roles of countries and districts are like provinces of a mid-sized country. Inside India's states, industrial dispersion took place. The result is like that of Amiti (1998), who analyzed industrial location in the EU and concluded that, after economic integration, which can be considered as trade liberalization, industries concentrated in selected countries. This does not contradict industrial dispersion inside a country.

3. METHOD TO MEASURE THE INDUSTRIAL CONCENTRATION/ DISPERSION

There are methods for calculating the concentration of industry or progress of dispersion. The Herfindahl index can be used to study the share of the output in manufacture, as Sjöberg and Sjöholm (2004) did. Nieto (2010) also utilized the Herfindahl index as well. This index indicates the degree of concentration, and is defined as

$$\text{Herfindahl} = \sum_{i=1}^N s_i^2$$

where s_i is a share of output of manufacture in province i .

The Herfindahl index does not explain the relationship between provinces. We should therefore be cautious about deciding that the concentration is eased when we find a decrease in the index. The decrease may come from the expansion of industrial activity to neighboring provinces. In that case, a decrease in the Herfindahl index may mean only that the metropolitan area continues to expand.

The present work uses data for the gross provincial product (GPP) of national accounts. The Office of the National Economic and Social Development Board of Thailand (NESDB) has released GPP figures for a long time series, available from 1974 to the present. As it is estimated by the production side, we can get not only the total GPP but also the value added in the manufacturing sector.

4. THAILAND

In this section, changes of industrial location in Thailand are surveyed. First, the timing of the change from import substitution policies to export oriented policies is discussed. Then the Herfindahl index before and after trade liberalization is calculated using the share of the manufacture in GPP in each province. The figures for share are used to discuss industrial dispersion over the longer term.

4.1. Timing of Trade Liberalization

Thailand, like other Asian economies, introduced import substitution policies in order to industrialize after World War II, and shifted to export oriented policies. How can we understand when this policy shift took place?

To provide an overview of middle term policy direction, it is useful to refer to development plans. The Thai government has decided a national economic and social development plan every five years since 1961 to provide the development guidelines and targets for policy making. The first development plan (1961-66¹) aimed to ramp up domestic industry under protection from outside competition. In the third development plan (1972-76), the government of Thailand prioritized the promotion of exports, which signifies a change of trade policies, but not enough to define a policy shift. The domestic market remained protected and measures to promote exports were limited.

Urata and Yokota (1994) and Kohpaiboon (2003) give us some hints about the timing. The former is a survey on improvement of productivity in Thailand, and the latter covers foreign direct investment, but both conducted a comparative analysis before and after trade liberalization. They regard the late 1980s as the turning point of which Thailand had a significant change of trade policy, to liberalization.

The fifth development plan (1982-86) emphasized improvement of production efficiency and strengthening of competitiveness. As part of this policy, a large tariff reduction was carried out in 1982. This period is an important transition time, but the story was not simple. As a result of decreases in government revenue, the Thai government could not maintain a low tariff policy, and tariff rates on machinery and other products were raised in 1985. Urata and Yokota (1994) show that the effective protection rate, as well as the nominal protection rate of machinery, rose in 1985 while the rates on total manufacturing decreased. The aim to improve competitiveness continued in the sixth development plan (1987-91). Policy direction and the actual situation regarding protection were somewhat confused during the mid-1980s. Significant tariff reductions on electrical and electronic goods, as well as their inputs, began in 1988. Finally, comprehensive packages of tariff reform were implemented in 1995 and 1997. Non-tariff barriers, such as import licenses, import quotas and local content requirements, were also improved.

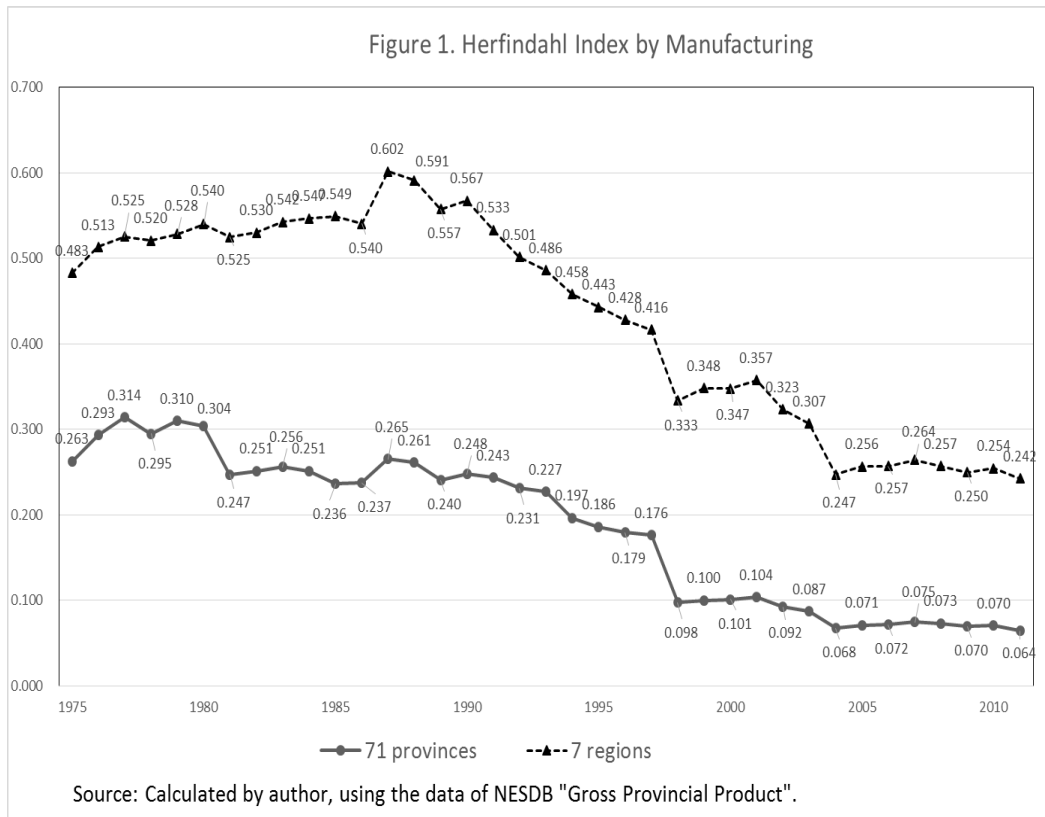
In summary, the trade policy of Thailand started as import substitution up to the 1970s, and showed signs of change in the late 1970s to 1980s. Although the final stage of trade liberalization was realized in the 1990s, the turning point from import substitution to export oriented policies was in the late 1980s. Some years may have been needed for the policy change to industrial location decisions by enterprises.

¹ The secretariat formulating the development plan is the NESDB. The first plan was a six year plan. After that, each plan has term of five years.

4.2. Industrial Dispersion

There are 77 provinces in Thailand. Of these, 6 provinces were established by division from other provinces after 1977². Figures for new provinces are included in their parent provinces for time series comparison. The figures for analysis in this paper are from 71 provinces.

Figure 1 is the result for the Herfindahl index of manufacturing calculated for 71 provinces (H_{71}) and 7 regions (H_7). The NESDB categorizes 7 regions, namely northeastern, northern, southern, western, eastern, central and greater Bangkok.



In the trend for H_{71} , the level of concentration of manufacturing grew during the 1970s and peaked in the late 1970s. After the peak in 1977, manufacturing production gradually dispersed, as is visible in recent years. On the other hand, the trend of H_7 shows that manufacturing continued to concentrate until the late 1980s, peaking in 1987. After that, H_7 gradually decreased due to dispersion. After the 1990s the trends for H_{71} and H_7 are almost identical.

The two indexes show different directions during the 1980s. The main reason is that expansion from the large city of Bangkok is described in different manners. As each element of H_7 is calculated from the aggregated group, expansion to neighboring provinces from Bangkok does not correspond to decreases in the index, whereas H_{71} describes the progress of dispersion.

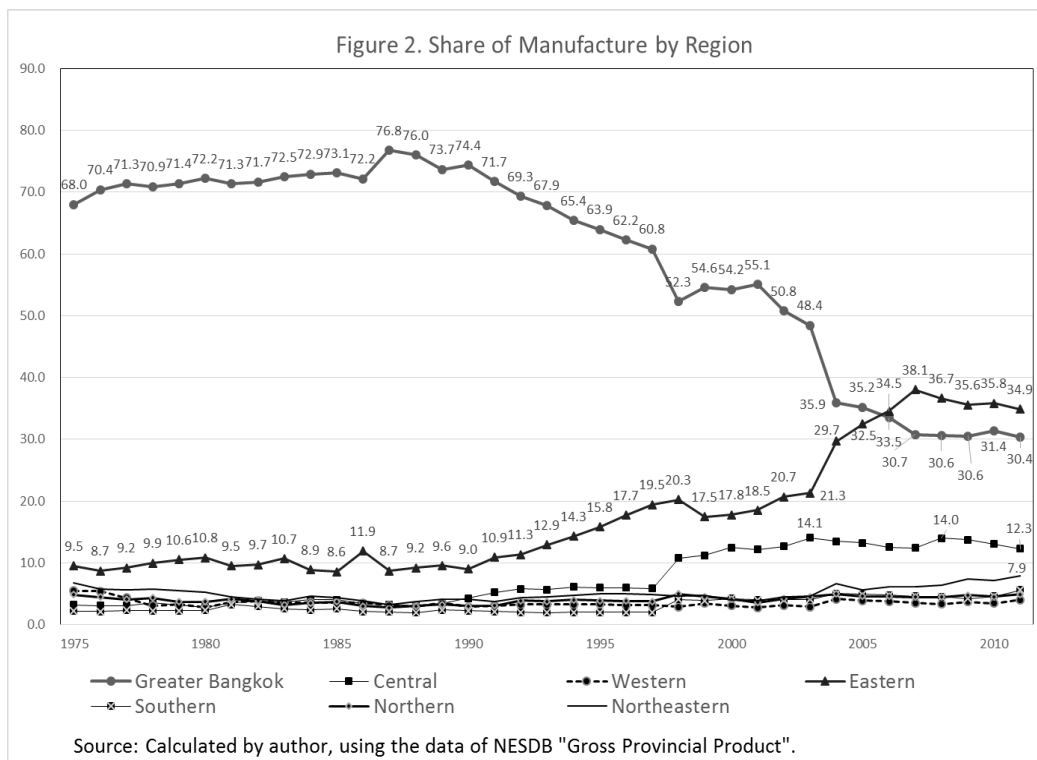
² Phayao Province was divided from Chiangrai in 1977, Mukdahan from Nakhonphanom in 1982, Nongbualamphu from Udonthani in 1993, Amnatchareon from Ubonratchathani in 1993, Sakaeo from Prachinburi in 1993, and Buengkan from Nongkhai in 2011.

In confirmation of the situation in the 1980s, Table 1 shows each province's rank of share of manufacture in 1975, 1980, 1990, 2000 and 2010. Figure 2 presents the aggregated share of manufacture by region.

Table 1. Manufacturing Share of Each Province

(Unit:%)									
	1975		1980		1990		2000		2010
Bangkok	48.6	Bangkok	52.2	Bangkok	46.2	Bangkok	21.4	Chonburi	13.1
Samutprakan	12.4	Samutprakan	13.8	Samutprakan	15.8	Samutprakan	15.7	Samutprakan	11.5
Chonburi	8.5	Chonburi	10.1	Chonburi	5.5	Phranakhon Sri Ayuthaya	8.8	Rayong	10.9
Pathumthani	3.5	Pathumthani	3.4	Pathumthani	5.3	Samutsakhon	7.5	Phranakhon Sri Ayuthaya	8.4
Ratchaburi	2.1	Saraburi	1.6	Nonthaburi	3.4	Chonburi	7.3	Samutsakhon	7.3
Kanchanaburi	2.1	Ratchaburi	1.2	Saraburi	2.8	Rayong	7.0	Pathumthani	6.9
Nakhonratchasima	1.5	Nakhonpathom	1.1	Samutsakhon	2.7	Pathumthani	5.6	Prachinburi	6.2
Nakhonpathom	1.4	Nonthaburi	1.0	Chachoengsao	1.6	Chachoengsao	2.8	Chachoengsao	5.4
Saraburi	1.3	Nakhonratchasima	1.0	Rayong	1.2	Nakhonpathom	2.5	Saraburi	3.4
Phranakhon Sri Ayuthaya	1.2	Samutsakhon	0.8	Nakhonratchasima	1.1	Saraburi	2.1	Nakhonpathom	2.9
Nonthaburi	1.1	Phranakhon Sri Ayuthaya	0.8	Nakhonpathom	1.1	Songkhla	1.9	Khonkaen	2.0
Samutsakhon	1.0	Khonkaen	0.8	Ratchaburi	1.0	Lamphun	1.9	Nakhonratchasima	1.8
Udonthani	1.0	Kanchanaburi	0.7	Phranakhon Sri Ayuthaya	1.0	Nonthaburi	1.4	Songkhla	1.6
Khonkaen	0.8	Nakhonsawan	0.6	Kanchanaburi	0.8	Ratchaburi	1.2	Bangkok	1.4
Chiangmai	0.8	Ubonratchathani	0.5	Khonkaen	0.7	Lopburi	1.2	Nonthaburi	1.4
Nakhonsawan	0.7	Surin	0.5	Chiangmai	0.6	Khonkaen	1.1	Ratchaburi	1.2
Lampang	0.5	Songkhla	0.5	Nakhonsawan	0.6	Nakhonratchasima	1.0	Lamphun	0.9
Kamphaengphet	0.5	Nakhonsithammarat	0.5	Nakhonsithammarat	0.4	Prachinburi	0.6	Suratthani	0.8
Suphanburi	0.5	Udonthani	0.4	Suratthani	0.4	Nakhonsithammarat	0.5	Kamphaengphet	0.7
Songkhla	0.5	Chiangmai	0.4	Buriram	0.4	Phetchaburi	0.5	Nakhonsithammarat	0.7
Ubonratchathani	0.5	Chiangrai	0.4	Chaiyaphum	0.3	Suratthani	0.5	Nakhonsawan	0.6
Surin	0.4	Lampang	0.3	Uttaradit	0.3	Kanchanaburi	0.5	Phachuapkhirikhan	0.6
Phachuapkhirikhan	0.4	Kamphaengphet	0.3	Suphanburi	0.3	Phachuapkhirikhan	0.5	Lopburi	0.6
Chaiyaphum	0.4	Phachuapkhirikhan	0.3	Udonthani	0.3	Chiangmai	0.4	Kanchanaburi	0.6
Chiangrai	0.4	Chaiyaphum	0.3	Phachuapkhirikhan	0.3	Nakhonsawan	0.4	Udonthani	0.5
Roiet	0.3	Phitsanulok	0.3	Ubonratchathani	0.3	Udonthani	0.3	Chiangmai	0.5
Phetchaburi	0.3	Uttaradit	0.3	Kamphaengphet	0.3	Phitsanulok	0.3	Ubonratchathani	0.5
Phetchabun	0.3	Nongkhai	0.3	Songkhla	0.3	Trang	0.3	Phetchaburi	0.4
Nongkhai	0.3	Buriram	0.3	Phuket	0.3	Suphanburi	0.3	Suphanburi	0.4
Buriram	0.3	Trang	0.3	Prachinburi	0.3	Singburi	0.2	Trang	0.3
Phitsanulok	0.3	Roiet	0.3	Nongkhai	0.3	Tak	0.2	Singburi	0.3
Prachinburi	0.3	Suphanburi	0.3	Chanthaburi	0.2	Chaiyaphum	0.2	Roiet	0.3
Singburi	0.3	Phetchaburi	0.3	Phetchaburi	0.2	Lampang	0.2	Buriram	0.3
Sukothai	0.3	Sukothai	0.2	Chiangrai	0.2	Satun	0.2	Chaiyaphum	0.3
Nakhonsithammarat	0.3	Prachinburi	0.2	Ranong	0.2	Roiet	0.2	Chiangrai	0.2
Suratthani	0.3	Suratthani	0.2	Phitsanulok	0.2	Chumphon	0.2	Lampang	0.2
Kalasin	0.2	Phetchabun	0.2	Tak	0.2	Buriram	0.2	Chumphon	0.2
Rayong	0.2	Nakhonphanom	0.2	Angthong	0.2	Ubonratchathani	0.2	Mahasarakham	0.2
Nakhonphanom	0.2	Kalasin	0.2	Lopburi	0.1	Kalasin	0.2	Kalasin	0.2
Phichit	0.2	Phichit	0.2	Singburi	0.1	Kamphaengphet	0.1	Tak	0.2
Sisaket	0.2	Sisaket	0.2	Lamphun	0.1	Surin	0.1	Chanthaburi	0.2
Chachoengsao	0.2	Chachoengsao	0.1	Sukothai	0.1	Angthong	0.1	Surin	0.2
Trang	0.2	Singburi	0.1	Lampang	0.1	Samutsongkhram	0.1	Chainat	0.2
Sakonnakham	0.2	Mahasarakham	0.1	Roiet	0.1	Nakhonphanom	0.1	Nongkhai	0.2
Uttaradit	0.2	Rayong	0.1	Yala	0.1	Yala	0.1	Phetchabun	0.2
Loei	0.2	Chumphon	0.1	Krabi	0.1	Chiangrai	0.1	Pattani	0.2
Phrae	0.2	Yala	0.1	Phichit	0.1	Mahasarakham	0.1	Phitsanulok	0.2
Samutsongkhram	0.2	Tak	0.1	Trang	0.1	Chainat	0.1	Samutsongkhram	0.2
Mahasarakham	0.1	Phuket	0.1	Surin	0.1	Phuket	0.1	Sisaket	0.2
Lamphun	0.1	Sakonnakham	0.1	Mahasarakham	0.1	Uttaradit	0.1	Phichit	0.2
Narathiwat	0.1	Narathiwat	0.1	Chainat	0.1	Phetchabun	0.1	Sakonnakham	0.2
Lopburi	0.1	Loei	0.1	Trat	0.1	Phrae	0.1	Krabi	0.1
Yala	0.1	Chanthaburi	0.1	Sakonnakham	0.1	Sisaket	0.1	Uttaradit	0.1
Chumphon	0.1	Lopburi	0.1	Pattani	0.1	Sakonnakham	0.1	Satun	0.1
Phuket	0.1	Phrae	0.1	Samutsongkhram	0.1	Pattani	0.1	Phatthalung	0.1
Chanthaburi	0.1	Phatthalung	0.1	Chumphon	0.1	Sukothai	0.1	Yala	0.1
Nan	0.1	Samutsongkhram	0.1	Sisaket	0.1	Narathiwat	0.1	Uthaitхани	0.1
Phatthalung	0.1	Nan	0.1	Nakhonphanom	0.1	Phatthalung	0.1	Nakhonphanom	0.1
Yasothon	0.1	Ranong	0.1	Narathiwat	0.1	Chanthaburi	0.1	Narathiwat	0.1
Chainat	0.1	Krabi	0.1	Kalasin	0.1	Phichit	0.1	Angthong	0.1
Angthong	0.1	Phangnga	0.1	Phatthalung	0.1	Nongkhai	0.1	Yasothon	0.1
Tak	0.1	Chainat	0.1	Phetchabun	0.1	Ranong	0.1	Sukothai	0.1
Pattani	0.1	Yasothon	0.1	Phangnga	0.1	Nan	0.1	Phrae	0.1
Krabi	0.1	Lamphun	0.1	Satun	0.0	Uthaitхани	0.1	Phuket	0.1
Phangnga	0.1	Pattani	0.1	Loei	0.0	Krabi	0.0	Loei	0.1
Ranong	0.1	Trat	0.1	Uthaitхани	0.0	Phangnga	0.0	Phangnga	0.1
Uthaitхани	0.1	Maehongson	0.0	Yasothon	0.0	Nakhonnayok	0.0	Nakhonnayok	0.1
Trat	0.1	Angthong	0.0	Phrae	0.0	Yasothon	0.0	Ranong	0.1
Nakhonnayok	0.1	Uthaitхани	0.0	Nakhonnayok	0.0	Loei	0.0	Trat	0.0
Satun	0.0	Satun	0.0	Nan	0.0	Trat	0.0	Nan	0.0
Maehongson	0.0	Nakhonnayok	0.0	Maehongson	0.0	Maehongson	0.0	Maehongson	0.0

(Source) Calculated by author, using the data of NESDB "Gross Provincial Product".



Bangkok used to have most manufacturing. The share of Bangkok peaked at 54.1% in 1977. After peaking, it continued to decrease gradually, to become below 40% in 1995 and was as low as 1.4% in 2010. Provinces of neighboring Bangkok still raised their share after 1970s. Samutprakan Province, for example, raised its share from 12.4% in 1975 to 15.8% in 1990. The share of greater Bangkok was 68.0% in 1975, and had risen to 76.8% in 1987 when H₇ was at its peak. It gradually decreased, while the share of the eastern region correspondingly rose.

The share of Eastern region was stable at around 10% until 1990, then rose to 35.8% in 2010. Rayong Province, whose share in 2010 was at 10.9% third highest in the country, had only a 0.1-0.2% share of manufacturing production before 1980. Its share rose gradually during the 1980s and accelerated from the 1990s, exceeding 10% from 2005. In contrast, Chonburi Province, which belongs to the eastern region but is located very close to Bangkok, followed a different pattern from either greater Bangkok or Rayong Province. The share of manufacturing was as high as 8.5% in 1975, and reached 10.1% in 1980. In the 1980s it fell until the early 1990s, and from the mid-1990s it rose again, to 13.1% in 2010.

The central region started to increase its share of manufacturing from the late 1990s. It reached 10% in 1998 and has remained above 10%. The northeastern region, which has a large population but is said to be the least developed region in Thailand, has not been so active in manufacturing, but has begun to increase its share recently. In 2010 its share reached 7.1%, with Khonkaen Province having a 2.0% share, greater than Bangkok at 1.4%. The western, southern and northern regions do not show any significant features.

4.3. Discussion

Based on the Herfindahl Indexes (H_{71} , H_7) and share of manufacturing, it is now discussed whether these results conform Krugman and Elizondo's model.

4.3.1. The 1970s

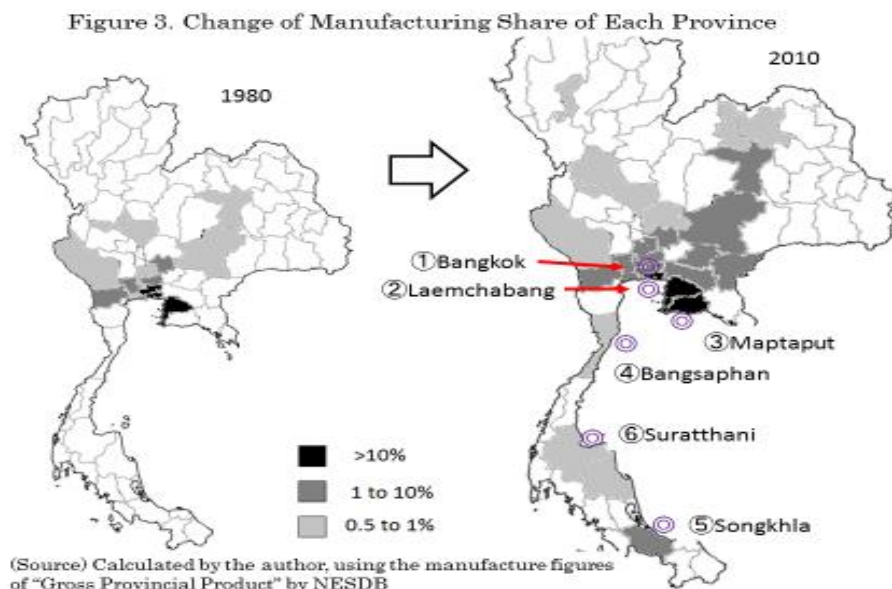
During the 1970s, when the trade policy was import substitution, Thai manufacturing continued to concentrate in the capital, Bangkok. This is clearly consistent with Krugman and Elizondo's model.

4.3.2. The 1980s

In the 1980s, the gradual decrease of H_{71} indicates that industrial dispersion had already begun. This did not happen through the relocation of industry to remote areas, but simply by expansion to neighboring provinces. Promotion of concentration in greater Bangkok makes Bangkok's role of a domestic market more attractive than the international market. At the same time, congestion costs rose and the production capacity in Bangkok reached its ceiling. As import substitution factors were stronger than export oriented factors until the late 1980s, industrial location during the 1980s shows the characteristics of Krugman and Elizondo's model during the late period of import substitution.

4.3.3. The Late 1980s to 2000s

We now consider industrial location under the hypothesis of export oriented policy from the late 1980s. The data indicate that Krugman and Elizondo's model applies. Values of H_{71} and H_7 both decreased during this period, implying that a widening of industrial location took place beyond greater Bangkok. The next question is whether the new located areas are borders. To answer this question, Figure 3 shows changes of the share from 1980 to 2010.



It is apparent that, in 1980, manufacturing industries were operating in a very limited area, mainly Bangkok and its surroundings. In 2010, manufacturing production was widespread throughout the country, and there are growing new industrial cores. Bangkok is losing its importance as a manufacturing core.

4.3.4. Role of Ports

The new cores are the provinces of Chonburi-Rayong, Songkhla, Phachuapkhirikhan, Suratthani and Lamphun. These provinces are all close to or include a seaport or airport.

According to Miyaji (2013) there are several seaports in Thailand (Table 2). During the import substituting period, Bangkok port was almost the only port. Even in recent years its amount of trade is large. Its port facilities are located along a river, so that expansion of width and depth are both difficult.

Table 2. Major Seaports of Thailand

Number of Figure 3	Name	Location	Notes
①	Bangkok	Bangkok	Operated by the Port Authority since 1951
②	Laemchabang	Chonburi	Started to operate in 1991 Offing from this port, Sriracha port locates. Furthermore, 5km from Sriracha port, there is an island port of Ko-Sichang.
③	Maptaput	Rayong	Started to operate in 1992
④	Bangsaphan	Prachuapkhirikhan	For development of western region
⑤	Songkhla	Songkhla	For development of southern seaboard
⑥	Suratthani	Suratthani	Local port

(Source) Arranged by the author using the information of Iuchi et al. (2013)

To handle increasing trade in goods, it was necessary to construct new ports. A proposal to construct a new port at Laemchabang in Chonburi Province did exist from the 1970s under the eastern seaboard development plan. The fifth development plan (1982-86) emphasized the need to develop the eastern seaboard. The Thai government facilitated the development of an industrial area for export oriented industry and heavy industry, utilizing newly discovered natural gas resources in the Gulf of Thailand. Construction began on new ports such as Laemchabang and Maptaput. Laemchabang port came into service in 1991, and continually expanded its capacity. Maptaput port opened in 1992. These became key facilities interconnecting manufacturers in Thailand with global markets and Chonburi and Rayong Provinces can act as new manufacturing cores under the export oriented policy.

The construction of Laemchabang port may explain changes in the manufacturing share of Chonburi Province. Its share of manufacturing was already high in the mid-1970s, and grew to 1980. The explanation is that Chonburi Province is very close to Bangkok, and that it expanded its production as a supply point near the main market. As the costs of congestion limited further expansion in the 1980s, manufacturers shifted from Chonburi. The eastern seaboard development plan also played a part. When building Laemchabang port and other infrastructure, Chonburi

Province found additional space for manufacturing industry with potential to become a trade center under the export oriented policies. After 1991, when Laemchabang port came into service, the manufacturing share of Chonburi Province rose again. Chonburi Province's role as a manufacturing center changed between the import substitution period and the export oriented period. In the latter, Laemchabang port acts as a border with the global market.

Other ports also acted as interfaces with the global market. Bangsaphan port in Phachuapkhirikhan Province is an interface for western development, and Songkhla port for southern seaboard development. Suratthani Province has a coastal port, although this is not considered as a major port for Thailand. Lamphun is an inland province but is close to Chiangmai International Airport. Although these are not main ports, and the amount of trade passing through them is limited, they support the export oriented industry as borders to the global market.

Phranakhon Sri Ayuthaya Province is difficult to study. The share of manufacturing of Ayutthaya increased from the 1990s, and apparently Ayutthaya utilized the global border comprising Dongmuang airport under the export oriented policy. Many firms utilize Laemchabang port for international trade, however, suggesting that manufacturing industry spread due to congestion costs of Chonburi Province.

4.3.5. Industrial Extension to Neighboring Countries

As well as showing new cores close to ports, Figure 3 suggests that industrial extension to borders is beginning. This is taking place in Udonthani Province, which is close to the border with Vientiane, the capital of Lao PDR, and Prachinburi-Sakaeo Provinces which lie close to the Aranyaprathet/Poi-pet border with Cambodia, and also Ratchaburi and Kanchanaburi Provinces facing Myanmar. If these neighbors are large enough economically to have domestic markets, the idea of Villar (1999) can be applied. According to Nozaki (2014), even though regional disparity among the GMS countries is still large and intra-regional economic linkage is low, the real income levels of neighbors have been rising, and intra-regional trade is increasing. Local manufacturers export their products to new markets. This shows the importance of infrastructure building, which reduces logistical costs. For example, expansion to Vientiane involves the first international bridge over Mekong River at Vientiane-Nongkai, which was almost the only way to connect Thailand and Lao PDR by track. Although the market of Vientiane is not large due to its relatively small population, industrial expansion took place towards Vientiane. The construction of a second bridge³ has not yet facilitated industrial expansion to Mukdahan Province.

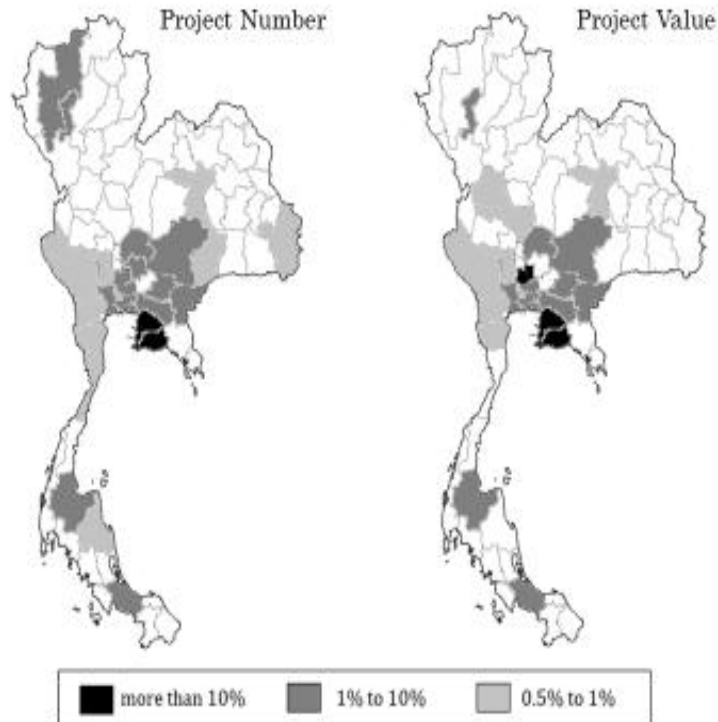
4.3.6. Future Directions

In the mid-term, investment projects act as leading indicators of manufacturing production, which is immediately visible. The Board of Investment of Thailand approves investment projects by granting privileges including foreign direct investment. The Board has released information on individual project in full detail, including the location, products or service, investment value and other parameters since 2008. The present author has compiled this information by province,

³ The first bridge was opened in 1995, and the second bridge in 2006.

excluding projects without manufacturing, such as software, international procurement offices and so on.

Figure 4. Share of Investments of Each Province during 2008-11



(Source) Calculated by the author, using the figures of "Investment Projects Approved" by Board of Investment of Thailand

The proportion of numbers and value of projects by province during 2008 to 2011 is shown in Figure 4⁴. The location of investment projects location resembles the location of manufacturing production in 2010. No further concentration in Bangkok has taken place, and core provinces containing ports attract investment projects. This situation suggests that the current dispersion will continue, but new investment cores or border cities which produce and export to neighboring countries would not spring up for some years.

In the long term, hard and soft infrastructure construction, such as the third and fourth international Mekong bridges or improvement of road conditions in Myanmar, or a legal framework that facilitates rapid progress, will increase intra-regional trade. These factors will influence the future location of manufacturing in border areas.

5. CONCLUSION

This paper has examined whether Krugman and Elizondo's model can be applied to industrial location with changes in trade policies in Thailand. Calculation of the Herfindahl index using GPP

⁴ Projects in 2012 have been excluded, as they were influenced by the flood in Thailand.

figures shows that the model is applicable to Thailand. In the 1970s, when the trade policy was import substitution, even the Thai government noticed the importance of export promotion, and the concentration of manufacturing production proceeded. In the 1980s, export oriented policies began, but trade protection practices such as high tariff rates were dominant. The industrial location map supports this observation. Industrial dispersion happened, but only inside the metropolitan area, so that the dispersion occurred due to the congestion cost of Bangkok and its surroundings, not by relocation to border areas. At the end of the 1980s, when comprehensive export oriented policies were implemented, industrial dispersion began and continued into the 2000s.

In fact, distinct from the case of Mexico, Thailand does not have a large market in neighboring countries, whereas Mexico had the United States as a neighbor. The border areas to accumulate the manufacturing production were not geographical borders with neighboring countries but provinces with ports, which have acted as interfaces to global markets. Thailand also differs from the case of Indonesia, because the main port of Bangkok is located along a river, which means that Bangkok port could not continue as the country's main port after the increase of trade by following the change of policy. The new port of Laemchabang on the eastern seaboard, and other ports including in remote areas played the role of borders.

As the income level of neighboring countries increases, changes of industrial location may occur. No clear sign of this was found in the present work. However, in recent years, some companies operating in Thailand have built satellite firms in neighboring countries. It may suggest the limitation of analysis under Krugman and Elizondo's model. An alternative framework of fragmentation by Jones and Kierzkowski (2005) should be applied for future research. Taguchi and Tripetch (2014), for example, is an empirical study to discuss the Thai-Myanmar border development by the concept of fragmentation. Considering the effect of decrease in service link costs to industrial location will assist in the evaluation and formulation of policy. This would help both Thai and neighboring authorities in formulating industrial policy so as to maximize regional effectiveness.

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