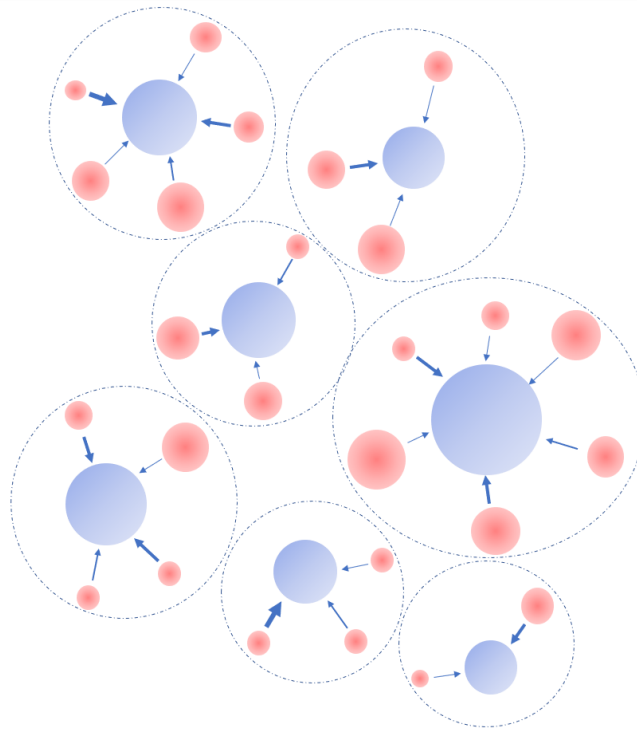


Economic dynamics in the Perak Diamond

A consideration of functional polycentricity



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1. Introduction

As Peninsular Malaysia further urbanizes, economic advancement increasingly pivots on the performance of its cities. This depends on a range of characteristics in the spheres of urban economy, society, business environment, spatial structure and governance. Leveraging agglomeration economies and positive externalities of proximity, mass and density, spatial structure is a challenge in accomplishing an efficient urban system in Peninsular Malaysia.

1.1 Peninsular Malaysia's urban system configuration

It has been increasingly recognized that Peninsular Malaysia's urban system and its main cities face several challenges in respect of spatial structure. These have been defined and analyzed in several reports and policy documents, including World bank (2015), National Urbanization Policy (NUP1 and NUP2, 2016-2026), as well as the third National Physical Plan (2015-2020), addressing the urban performance issues at city and conurbation level, whereby, in line with mainstream approach, the urban system is conceived as hierarchical.

However, it is increasingly argued that there are shortcomings to the hierarchical approach at regional and sub-regional level. Indeed, concerning spatial structure, insights are advancing of the relevance to performance of dimensions beyond city size. At the regional and sub-regional scale these refer to urban configuration reflecting internal spatial structure, and, respectively, to functioning and inter-settlement structure. At both levels, density and mass related characteristics are associated with economies and productivity. Specifically, at the lower level these include land use and integration, as well as connectivity, emphasizing the role of morphological and functional features against a hierarchical inter-settlement structure mostly holding back productivity. This is translated into the view of assemblages of proximate urban centers displaying high connectivity, constituting polycentric urban regions, thus 'producing' agglomeration economies through 'combined' or 'borrowed' size (van Grunsven, 2019).

1.2 Polycentric urban development

The notion of polycentricity has been given attention by policy makers, who widely adopted such concept development and planning strategies. As a matter of fact, the European Spatial Development Strategy (EC, 1999) placed polycentricity at the heart of current spatial planning policies across Europe (Green, 2007). In academics, Meijers et al. (2007, p. 7) define a polycentric development policy as '*a policy that addresses the distribution of economic and/or economically relevant functions over the (spatial) system in such a way that the urban hierarchy is flattened in a territorially balanced way*'. According to such policies, polycentric development in a region can be used as a strategic instrument to achieve multiple goals towards more efficient, balanced and sustainable patterns of spatial development, enhancing performance and productivity (Burgalassi, 2010; Commission of the European Union, 1999).

The necessity of steering the development of the urban system and its cities in a different direction is argued on several grounds. In fact, rather than privileging higher order centers from efficiency considerations and focusing on

independent growth of individual centers, the focal point should shift towards spatial structure elements of urban structure and spatial configuration. It is held that performance would benefit from defragmentation and polycentric urban structure if emphasized through connectedness and interactions (van Grunsven, 2019).

1.3 Scientific relevance

The divergence between hierarchical approaches and studies on polycentric urban configurations underlines the need of a complementary Research to the ‘Malacca Straits Diagonal’ (MalaccaStraitsDiagonal, 2018). In this report, the vision entails a potential for the Western Coast of Peninsular Malaysia to be shaped by a succession of urban conurbations and so-called “Diamonds”, which are structures encompassing networks of cities forming morphological and functional polycentric urban configurations (Figure 1). In particular, the concept of “Perak Diamond” is put forward as the potential configuration of the area between the two main urban nodes of Greater Penang and Greater Kuala Lumpur. It would span most of the coast of the state of Perak, shaped by the functional area that is formed by the isochrone of 1-hour travel from Ipoh, and the isochrones of 30 minutes from the cities of Lumut, Teluk Intan, Taiping, and Tapah. In terms of the Diamond’s urban system, it is argued to be predominantly led by Ipoh and, according to this vision, it would potentially represent a strategic node articulating the connection between Penang and Kuala Lumpur, filling a void in the settlement system of the Diagonal (MalaccaStraitsDiagonal, 2018).

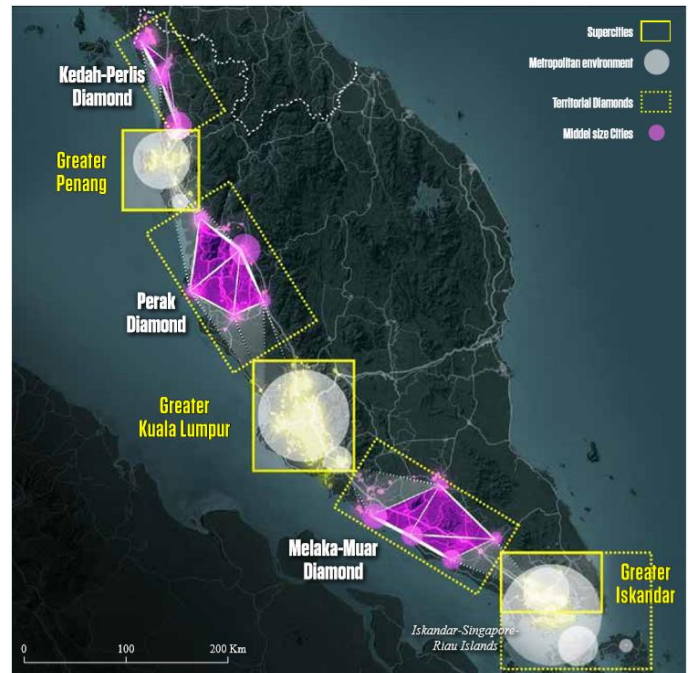


Figure 1: Malaysia Straits Diagonal and Perak Diamond, retrieved from Fundacion Metropoli/ThinkCity (2018)

1.4 Approach of the Research: main theme and focus

In practical terms, our Research approach targets regional urban system development and functioning in Perak, aiming at unravelling the configuration and functioning of regional urban settlement systems, including current presence of polycentricism, as evidenced by inter alia functional areas of centers, interaction patterns, distribution of investments and economic function, overall urban mass and performances. Consequently, the potential to develop or augment mass through urban polycentricism at regional level is investigated (van Grunsven, 2019).

Considering the need for in-depth analysis to appraise development and performance of regional and sub-regional urban systems, as well as the focus on the potential of polycentric spatial structure at regional level, the Research approach opts for a case study. The Perak ‘Diamond’ (Figure 2), as demarcated in the ThinkCity ‘Reconceptualizing Malaysia’s Urban Future’ draft report (2018), is scrutinized in detail to unravel the characteristics of the physical and socio-economic environment, physical connectivity, and intra- and inter-center interactions of individual urban centers in the Perak urban

system. From this starting point, it is in our interest to inspect the eventual presence of polycentricism in the functioning of the regional urban system, assessing its relevance from the perspective of performance related to urban structure and inter settlement configuration. It follows an investigation of the potential for the urban region constituted by the Perak Diamond to develop or enhance polycentricism with a view to building more agglomeration economies, density and mass, deriving into feasible performance gains (van Grunsven, 2019).

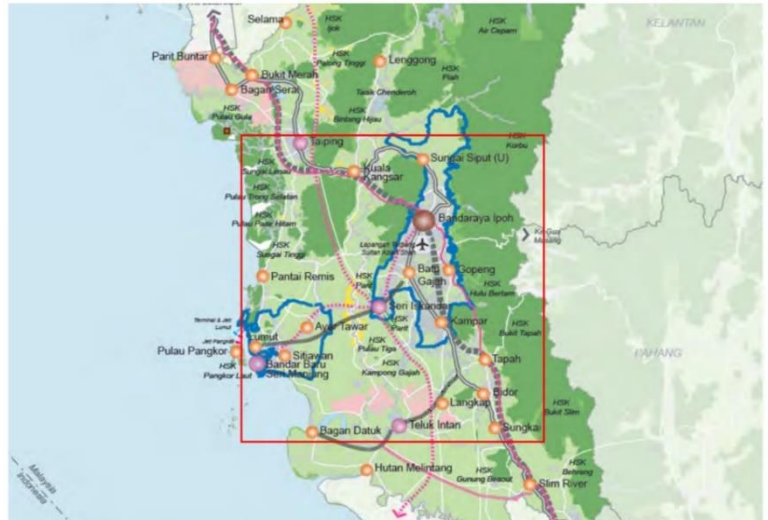


Figure 2: Perak urban system and demarcation of potential settlements for regional polycentricism (ResearchProposal, van Grunsven 2019)

Providing the basis for and criteria in the definition of polycentricism, several dimensions are addressed:

- *Morphology*: equal size urban centers located in proximity
- *Functional*: economic specialization and complementarity; borrowing size and economic 'scale'
- *Relational*: multi-directional connectivity and flows, with a minimum and maximum time taken to cross distance
- *Institutional*: coordination-driven integration

1.5 Aim of the Research

In this Research, the focus is on the polycentric functional/relational side of urban configuration. On a general note, this dimension can be explained through the notion that *"in a polycentric urban system the small and medium-sized towns and their interdependencies form important hubs and links"* (Commission of the European Union, 1999, p. 24). Moreover, flows in polycentric regions should be characterized by lower hierarchical restrictions. The result should be a relative "symmetry" of flows in polycentric regions, with no dominant center attracting flows from all the others, which would instead indicate a monocentric urban configuration (Kloosterman and Lambregts, 2001), and mutual interdependencies between the centers. This, as explained in detail in the Theoretical framework section of the Research, is investigated through the analysis of specialization and diversification dynamics, as well as the interconnectedness of sub-regional entities in the regional economy of Perak.

To fully understand the role of polycentricity in economic outcomes, alongside the morphological dimension, empirical Research that utilizes the functional and industrial dimensions of the concept becomes central. In past studies, most of the existing empirical evidence is built on node features, through which inter-firm interaction is described by distance and the size of nodes with a variety of methods e.g. location quotients, rank-size relations, sufficiency indices, and employment-to-work ratios (Limtanakool et al., 2007; Camagni and Capello, 2004). In this respect, the Research identifies relatedness notions and measures as the most appropriate method of analysis. Also, recognizing that the investigation of urban configuration deals with on-going processes that can only be explored fully through methodologies

that deal directly with the agents doing the networking (Taylor et al, 2008), the nature of the Research becomes a multidisciplinary one. In other words, as explained in the Methodology section, it takes advantage of both quantitative and qualitative methods, where Companies and Governmental agencies are identified as main agents shaping urban structures.

Producing relevant insights and complementing the “Malacca straight Diagonal” and “Perak Diamond” studies conducted in the recent past, this Research seeks to investigate the urban configuration of Perak and, in turn, shed light on the presence of polycentrism in the region as well as potential development of such structure. Explicitly, the aim is to identify the urban structure of Perak, thus verifying the potential and efficacy of the development of a polycentric Perak Diamond.

1.6 Research Question

As anticipated in the Introduction section, the Research seeks to answer a specific set of Research Questions relative to the functional urban structure of Perak. Such questions, once investigated, will provide the reader with a complete view over the industrial composition of the region, its historical evolution and its characteristics in terms of specialization, diversification and interconnectedness of urban centers.

1. *What are the strengths and weaknesses of the economic structure of Perak compared to other States in Peninsular Malaysia?*
2. *Does Perak present a diversified or specialized economic structure at the regional level?*
3. *Do sub-regional units in Perak specialize or diversify over time?*
4. *Do sub-regional units in Perak diversify in sectors related to the pre-existing portfolio of sectors in the territory?*
5. *What is the Relative Competitive Advantage of each sub-regional unit in Perak? And how does this change over time?*
6. *Where can we observe the highest concentration of firms/employment in specific sectors? How does this composition change over time?*
7. *Do sub-regional units in Perak act as complements or substitute of each other's?*
8. *Do Development Corridors influence the distribution of sectors in cities of Perak?*
9. *Does the spatial (economic) evolution of Perak indicates the presence of “borrowed size” and “agglomeration shadow” phenomena?*

Finally:

- ❖ *Do these functional characteristics indicate a Polycentric, Monocentric, or Archipelago structure of the region of Perak and its sub-units?*

Starting from the anticipation of Perak as a polycentric regional system, the Research Questions introduce a set of conditions to be tested through our analysis. Such propositions allow us to verify whether the functional configuration of Perak can indeed be described as a polycentric system or, alternatively, as a monocentric or archipelago structure.

1. *Perak presents a diversified economic structure at the regional level.*
2. *Cities in Perak specialize over time.*
3. *Cities in Perak specialize in sectors related to their economic portfolio.*
4. *Economic sectors are evenly distributed across cities in Perak. This trend is expected to become more visible when considering the historical evolution of the region.*
5. *Cities in Perak act as complement of each other's.*
6. *Development economic corridors enhance sectoral complementarities in Perak*

1.7 Outline of the Research

After introducing the context of the Research (Section 2), where the characteristics of the study area are described, the investigation proceeds with the Theoretical Framework (Section 3), supporting the construction of a dedicated Model conceptualization. It follows an explanation of the Methodology utilized (Section 4), alongside with the description of data sources, both quantitative and qualitative. Before concluding with a Conclusion and Reflection (Section 6), the Research presents the analysis of specialization and diversification dynamics of the regional and sub-regional urban configuration of Perak (Section 5)

2. Context of the Research

The following section presents an overview of the State of Perak, which represents the geographical unit of analysis in the Research. As anticipated, the objective is to shed light on the urban configuration of the region, verifying whether a polycentric structure can indeed be identified. As the boundaries of the so-called Perak Diamond are not definite and require further analysis, the following section describes the totality of the Perak region, which is consequently investigated through quantitative and qualitative methods¹.

2.1 Introduction to the study area

The State of Perak is located in Peninsular Malaysia, in South-East Asia. It is one of the thirteen States of Malaysia, and the fourth-largest one (DOSM, 2019). It borders Kedah at the North, Penang to the Northwest, Malacca to the West, Selangor to the South, Kelantan and Pahang to the East and Thailand to the Northeast (Figure 3).

Perak is divided into 10 administrative districts (Figure 4), which are further divided into Municipal councils². The State's administrative capital is Ipoh but the Royal capital remains Kuala Kangsar, where the palace of the Sultan of Perak is located (PerakBaselineStudy, 2015).

In Perak, the signs of the Dutch colonialism, in the 17th Century, and the British Colonialism, in the 19th Century, are still visible to this day in its history, culture and economy. Favored by a strategic location and abundant natural resources, Perak has historically been benefitting from the tin-ore trading. This advantage was translated, in Perak's earlier history, in an economic and cultural flourishing. Nevertheless, because of the gradual depletion of natural resources and the drop in the price of tin-ore, the once most populous State of Malaysia is now experiencing an economic downturn and a massive manpower drain to higher-growth neighboring states such as Penang, Selangor and Kuala Lumpur (Mun, 2007).

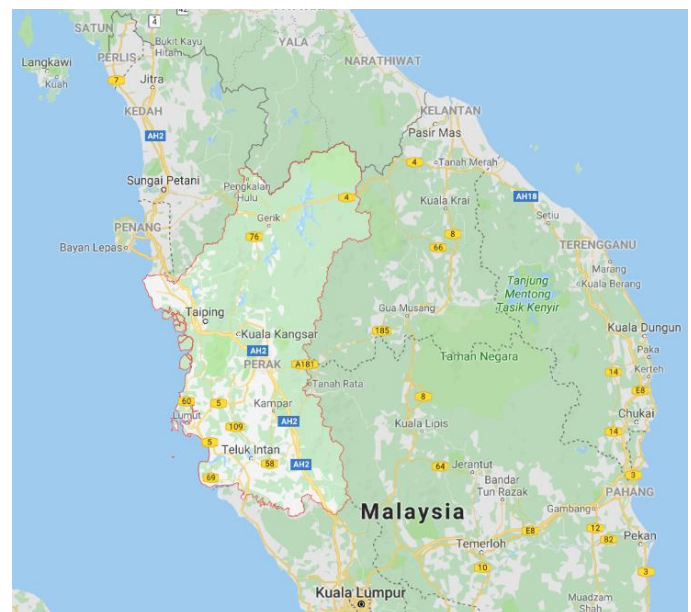


Figure 3: Location of Perak, retrieved from GoogleMaps (2019)

¹ As further specified in the Methodology section, the necessity of including all 10 administrative districts of Perak in our analysis is dictated by computational reasons. In fact, Relatedness measures and the consequent analysis of specialization and diversification dynamics benefit from a larger pool of observations and, in this specific case, locational units. Following this line of reasoning, this section introduces main cities and towns distributed across the whole region of Perak (Section 2.5)

² The division among administrative districts is not clear in the Governmental documentation of Perak, that in some cases indicates 12 (Muallim and Selama are added). In this Research, 10 administrative districts are utilized (Figure 4)

2.2 Demography

Perak, in 2017, had a population of 2.54 million inhabitants (DOSM, 2017). The population, alongside with urbanization, has grown in the last 3 decades, but it has not increased at the same pace as other areas in Malaysia. When looking at the geographical distribution of its population, it is noted that the majority is concentrated in the Kinta district (823.000), where Ipoh is located, followed by Manjung (252.000) and Larut-Matang-Selama (357.000) (DOSM, 2017) (Figure 5).

District	Population in 2017
Kinta	823.000
Hulu Perak	101.000
Larut-Matang-Selama	359.000
Kerian	194.000
Kuala Kangsar	173.000
Perak Tengah	111.000
Manjung	252.000
Hilir Perak	227.000
Batang Padang	198.000

Urban area	Total population per year*		
	2000	2010	2016
Ipoh	552121	669218	730900
Taiping-Kamunting	163730	207640	230500
Lumut-Sitiawan	143893	178916	199500
Teluk Intan	77361	88695	100700
Kampar	57389	69940	77700
Sungai Siput	43385	48954	54700
Kuala Kangsar	44773	49226	54600
Batu Gajah-Pusing	39434	49095	54000
Seri Iskandar	23468	43062	52600
Tapah	29264	33959	40200
Bidor	30389	31244	34700
Pantai Remis	28045	28832	30400
Gopeng	23998	26363	28400
Total	1,257,250	1,525,144	1,688,900

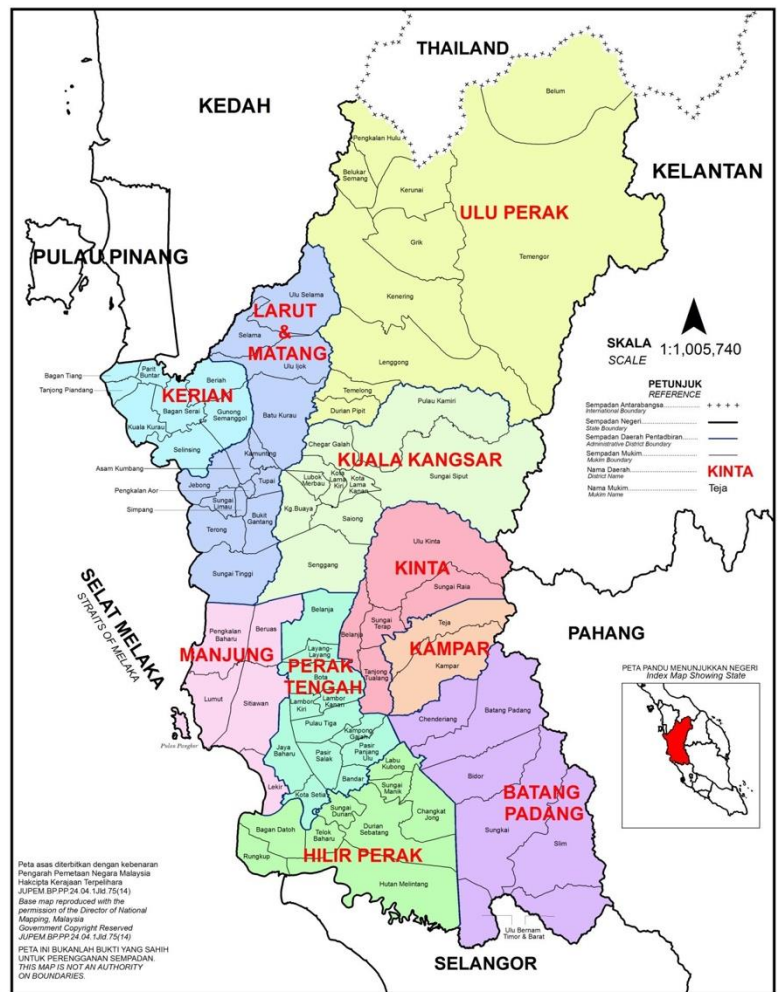


Figure 4: Districts of Perak, retrieved from Bureau of Statistics (2010)

Figure 5: Perak Population per district DOSM (2017) & Population in major urban centers (Daan Florijn's Research, Authors calculations, based on the population census (2000, 2010) and Data Asas Negeri Perak (2016)

2.3 Economy

Perak has a long history as a mining State and it is estimated that close to RM 1billion worth of minerals is generated annually in the State (PerakBaselineStudy, 2015). In addition to the mining industry, Perak has an established agriculture and fishing industry. On a geographical side, rubber plantations are found in the central area of the region, padi is in the Northwest and South and palm oil plantations at the border with Selangor (RancanganStrukturNegeriPerak2020, 2008, JPBD Perak). In the last few decades, however, the State has undergone economic structural changes. In fact, during the 1980s and 1990s, manufacturing and services began to replace agriculture and mining as prime economic drivers (InvestPerak, 2016).

Perak also hosts several touristic attractions. Cultural, heritage and natural assets are mainly concentrated in four distinctive clusters: Food, heritage and mining history in Ipoh and its surroundings; maritime attractions in Lumut; archeological and geological sites in Lenggong; and zoological, botanical and heritage interest points in Taiping (Rancangan Struktur Negeri Perak 2020, 2008, JPBD Perak).

2.4 Infrastructure

Perak is sufficiently endowed with basic infrastructure. Main connections are the North-South highway and the recently completed electric rail service, connecting KL to Padang Besar. Also, as visible in the figure (Figure 6), the region hosts three airports, a container port, bulk port, inland port and marina (PerakBaselineStudy, 2015).

2.5 Cities' profiles

When zooming into the cities of Perak, their profile can be described in terms of administrative, cultural and economic characteristics. In this section of the Research, an introduction to a selection of cities and districts is provided to contextualize the locational area of our study. As anticipated, the cities' profiles description is not limited to the hypothesized Perak Diamond, as the Research argues that its boundaries require an analysis for the totality of the State and its main cities.

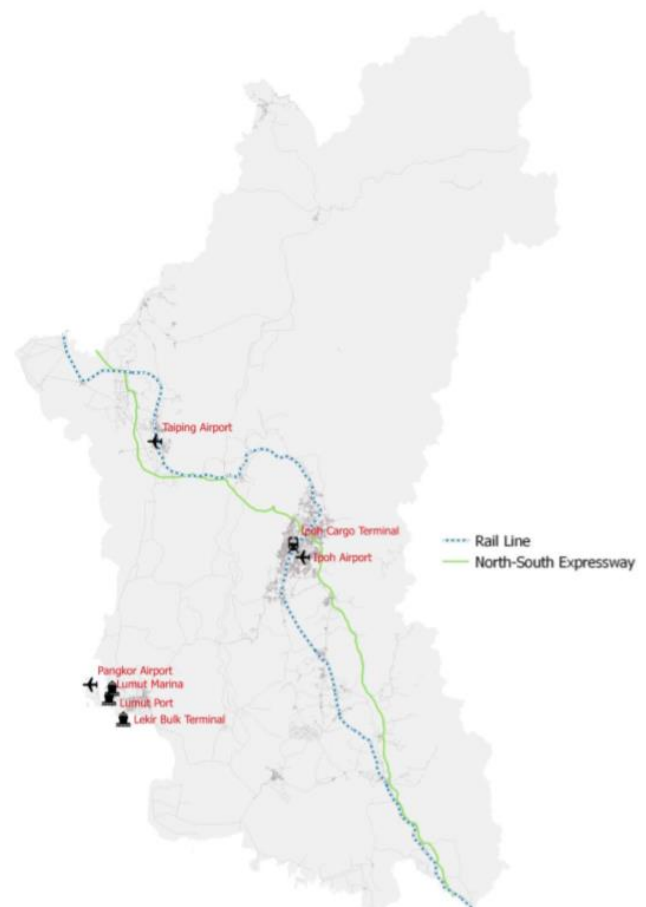


Figure 6: Perak basic Infrastructure, retrieved from PerakBaselineStudy (2015)

Ipoh

With a population of more than 700.000 people, forecasted to increase to 800.000 by 2020 (Population Census, 2000-2010 & Data Asas Negeri Perak 2016), Ipoh is the largest urban center in Perak, and it is recognized in the State Structure Plan as the State capital (Perak State Structure Plan 2020).

Originally a tin mining town, Ipoh is emerging as regional service and manufacturing center. Main functions include public, retail, health and education services. Furthermore, the city specializes in E&E, fabricated metal products, natural resources, machinery and transport equipment. As anticipated in the Infrastructure sub-chapter, Ipoh also hosts the only inland port in Perak. Looking at current and future economic development, The Ipoh Local Plan promotes a multi-nucleus urban structure featured by a commercial town center, aviation industry to the South, tourism oriented area to the East, an industrial and a high tech center to North and heavy industry in the East (Perak Baseline Study, 2015).

Kamunting and Taiping

Taiping is the second largest urban center in Perak with a population of more than 217.000 (Population and Housing Census, 2010). It is recognized in the State Structure Plan as district capital. Other than a district level administrative, services and commercial center, Taiping is featured by heritage, culture, tourism, recreation and education assets serving as supplementary functions (Perak State Structure Plan 2020). Kamunting, located in vicinity of Taiping, hosts one industrial estate mainly focused in rubber products. Looking at current and future development plans, Kamunting is the subject of a Blueprint by the Perak Economic Planning Unit that aims at revitalizing its service and manufacturing sectors, as well as infrastructure and education (Economic Planning Unit, Greater Kamunting Transformation Blueprint, 2014).

Kampar-Bidor-Teluk Intan-Tapah

These four cities, located in the Southern part of the region, have a combined population of more than 105.000 inhabitants (Population and Housing Census, 2010). Historically, Kampar's economy was based on tin mining but, following a decline after the establishment of the North-South Expressway, it has re-emerged as a university town, where Tunku Abdul Rahman University College and the Universiti Tunku Abdul Rahman host more than 20.000 students (Perak Baseline Study, 2015). Teluk Intan, with a population of nearly 42.000 (Population and Housing Census, 2010) is recognized in the State Structure Plan as district capital. It serves as service hub to surrounding agriculture and is a relatively important institutional center (Perak State Structure Plan 2020). Bidor and Tapah are significantly smaller towns, categorized as local service centers featured by an abundance of agricultural and residential land (Perak State Structure Plan 2020).

Kuala Kangsar

Kuala Kangsar has a population of approximately 54.600 (Population Census,2000-2010 & Data Asas Negeri Perak 2016), and is the Royal capital of Perak. In the State Structure Plan is defined as a high order local center. Other than being a district administrative center, it is identified as a relevant hub in terms of higher education, higher order commercial services, tourism and industrial hub specializing in food, agricultural and timber products (Perak State Structure Plan 2020). Also, Kuala Kangsar's relative importance is associated with its role as gateway to the region.

Lumut-Sitiawan

Lumut-Sitiawan, with a combined population of 199.500 (Population Census,2000-2010 & Data Asas Negeri Perak 2016), is recognized in the State Structure Plan as district capital (Perak State Structure Plan 2020). Lumut, alongside Ipoh and Taiping, is among the most important urban centers of Perak. Its main asset is recognized in the secondary port and bulk terminal, which includes a ship building and repair industry (PerakBaselineStudy, 2015). The townsite itself is relatively small, but there are significant industrial and residential hubs located in the Northern and Eastern periphery (Malaysian Department of Statistics, Data Bank, 2012), including Sitiawan, with a population of approximately 20.000 (Population and Housing Census, 2010). Surrounding agriculture is centered on palm oil plantations and industry includes oil and gas, fabrication, iron-ore distribution and ship building.

Seri Iskandar

Seri Iskandar has a population of approximately 52.600 residents (Population Census,2000-2010 & Data Asas Negeri Perak 2016). It is known for its role as higher education center, characterized by a high proportion of institutional land use. As a matter of fact, it hosts the MARA University of Technology, Kolej Profesional Mara Seri Iskandar, Institute Kemajiran Belia Negara and the University Technology Petronas (PerakBaselineStudy, 2015).

Kerian

Kerian is a local municipality in the Northeast of the State on the Penang border. It has a population of approximately 120.000 inhabitants (Population and Housing Census, 2010). The main towns within the municipality are Bagan Serai (8.304), Kuala Kurau (5.454) and Parit Buntar (3.857). Kerian, centered around the agricultural sector, is also characterized by potential nature-based tourism assets. Economic strengths are identified in rice padi's cultivations, alongside livestock, fruits and aquaculture (Malaysian Department of Statistics, Data Bank, 2012).

Lenggong-Gerik

Lenggong, with a population of 2.013 inhabitants, and Gerik, with a population of 2.677, are located in the Northern periphery of the State (Population and Housing Census, 2010). Both are service towns serving surrounding rubber plantations and other agriculture activities. Gerik is also the administrative center for the Hulu District. (Perak State Structure Plan 2020).

Tanjung Malim

Tanjung Malim is a municipality on the Perak's Southern border. It has a population of 50.000 and comprises the towns of Proton City, Behrang, Sungkai and Slim River (Population and Housing Census, 2010). Specifically, on an economic side, Proton City is a 1.600 hectares industrial, commercial and residential development with the Proton assembly factory at its core. When fully developed, it is expected to have a population of 240.000 inhabitants (Perak State Structure Plan 2020).

2.6 Current and future development plans

The cities' profiles described introduce the relative strengths of different locational units, reflected into Governmental plans. In this respect, the Perak 2020 Regional Plan provides a comprehensive description of current and future development targets to spur the economic and social environment of Perak in the upcoming years. In this Research, particularly, we focus on four projects: the so-called Economic Corridors. The State Government is indeed planning for the implementation of certain areas aiming to foster projects in all of the ten districts in Perak, in accordance with their individual advantages and strengths (PerakBizRoute, 2015). In particular, four corridors are targeted.

The Northern Economic Corridor incorporates the districts of Kerian, Larut-Matang-Selama and Kuala Kangsar. It comprises the Parit Buntar industrial corridor, Taiping Municipal Council, Bukit Merah and Selama (Appendix 1). In this Corridor, the State has identified manufacturing, real estate and tourism as strategic industries to economic development. Among the numerous projects are found the Bukit Merah Lake development project, the Lembah Beriah mixed use development, the Eco-tourism development, historical legacy, commercial centers and highland resorts. Also, the plan comprises the requalification of the Royal Town and the Small & Medium Enterprises development program (PerakBizRoute, 2015).

The Central Economic Corridor covers the districts of Kinta, Perak Tengah and Manjung. It incorporates the cities of Ipoh, Batu Gajah and Kampar, Seri Iskandar and Perit, Lumut, Seri Manjung, as well as the Kampung Acheh industrial park (Appendix 1). Driven by Kinta, the administrative center of Perak, the Central Economic Corridor is argued to be a major source of attraction for investors. It follows that, in this area, the industries related to commercial, industrial, public and private education and maritime industry are identified as key to economic development. Among the numerous projects, one can find the State administrative center, the Center of education excellence, the International tourism hub, Palau Sembilan marine park and Lumut port city (PerakBizRoute, 2015).

The Southern Economic Corridor includes the districts of Padang Badang and Hilir Perak. It covers an area that spans from Slim River to Tanjung Malim, from Tapah to Bidor Sungkai, and from Teluk Intan to Langkap (Appendix 1).

Proton, a major manufacturer in the Malaysian automobile industry, is located in the vicinity of Tanjung Malim. Therefore, the automobile industry has been selected as key industry to economic development in the Southern Economic Corridor. Secondary support sectors comprise agriculture and education. Among the multitude of development projects are found the Proton city development, the Sultan Idris Education University, the Natural Institute of Land & Survey in Behrang Ulu, the Sultan Azian Shah Polytechnic Tanjung Malim, as well as boat manufacturing, fishing, and papaya and rice cultivation (PerakBizRoute, 2015).

The Northeastern Economic Corridor comprehends the districts of Hulu Perak and Selama (Appendix 1). In these two areas, the economy is still strongly related to the agricultural sector and, as a matter of fact, the State Government has identified agriculture, eco-tourism and R&D as key industries to economic development. Among numerous projects are the Aquaculture Research and Development center, Pulau Banding, Royal Belum State Park, Kroh Free Trade Zone Northern gateway and the Lenggong Archeological Museum (PerakBizRoute, 2015).

The relevance of the inclusion of Economic Corridors in our Research stays in the fact that it is in our interest, as further explained in the Methodology section of the Research, to evaluate the effective sustainability and effectivity of such initiatives. This discourse, in turn, is used to underline the issue of a State-based mentality in Perak, which is argued not to take full advantage of tailored specific strengths belonging to its sub-regional units.

3. Theoretical framework

The theoretical body of our Research serves as a base for the analysis of the connection between diversification and specialization dynamics and urban structure, tackled from a relatedness perspective. It starts by delineating the main components of our argumentation, relatedness notions and urban configuration, and proceeds by linking these two pillars together in an attempt to unravel the economic spatial structure of Perak. The Theoretical framework is then concluded with a Model Conceptualization to offer the reader with an upfront outline of the analysis conducted.

3.1 Relatedness in Economic development dynamics

The concept of relatedness plays a key role in linking knowledge spillovers to economic development, economic renewal and new growth paths (Asheim et al., 2011). It indicates the variety of cognitively related industries within a spatial entity (Frenken et al., 2007) and takes full advantage of local sources of growth and learning opportunities for new and existing industries (Boschma, 2014). In the relatively recent debate concerning Marshall and Jacobs externalities, relatedness' notions are empirically applied to investigate the effects deriving from localization economies and inter-industrial spillovers, respectively promoting economic benefits associated with specialization and diversification (Glaeser et al., 1992). These interactions allow for the recombination of knowledge and capabilities among heterogeneous industries, exhibiting a significant influence on the development of economic environments over time.

In the recent literature, two facets of relatedness are recognizable. Firstly, this concept is associated with Jacobs-type externalities among related sectors, being closely linked to the notion of the recombination of pre-existing knowledge to generate new products and services advanced by Schumpeter (Nooteboom, 2000). In fact, spillovers within a spatial unit primarily occur among related sectors, and only to a limited extent among unrelated sectors (Frenken et al., 2004). Secondly, relatedness notions are associated with the concept of economic resilience, where the presence of sectoral diversification reduces the risk of interdependent, sector-specific asymmetric variations that would prompt long-term unemployment and economic deterioration (Boschma and Iammarino, 2009). If one wanted to summarize the objective of relatedness approaches, it could be said that this concept aims at investigating the most suitable composition of industries for the economic development of a specific location. In fact, relatedness has been used to outline the extent to which a region's different industries share commonalities that allow the occurrence of knowledge exchange and spillovers, endorsing regional diversification and new growth directions (Boschma and Gianelle, 2014). Other than assessing the present composition of industries and technologies, relatedness approaches identify unexploited potentials adjusted to the exact needs and available resources of a specific spatial unit (Boschma, 2014). Consequently, within the smart specialization framework, relatedness is about identifying and leveraging context-specific intangible assets of a spatial unit, attempting to follow pathways towards the construction of regional advantage in new activities and markets (Boschma, 2014). Such mechanisms derive from the evolutionary notion that knowledge production is depicted as a cumulative, path-dependent, and interactive process (Atkinson and Stiglitz, 1969; Dosi, 1982; Nelson and Winter, 1982). Therefore agents, driven by uncertainty, develop on knowledge assimilated in the past, providing opportunities and setting boundaries to the learning process of economic networks (Cohen and Levinthal, 1990).

An extensive succession of literature analyses the role of relatedness in the process of geographical diversification. Here, the so-called geographical dimension, or spatial unit, is scrutinized on several levels. At the supra-regional level, the existing set of capabilities determines which new industries will be feasible, and most likely, to develop in the future (Hausmann & Hidalgo, 2010). Additionally, countries are more likely to move towards new export products which are related to their present export portfolio (Hausmann and Klinger, 2007). Zooming in, at the regional level, since capabilities' mobility within countries is limited, regions own distinctive competences and skills, outlining which new industries are more likely to appear and develop in the upcoming future (Neffke, 2009). In a similar way to supra-regional dynamics, a new industry is more likely to enter a region when it is related to other pre-existing industries in loco, and an existing industry is more likely to exit a region when it is not, or poorly, related to other pre-existing industries in place (Boschma et al., 2013). The third geographical dimension is the city-level, where cities' characteristics are the drivers of the regional diversification process of industries and technologies (Boschma and Balland, 2015). In cities, Jacobs' externalities are associated with an urban structure composed of a variety of industries that spur creativity and innovations, enable the cross-fertilization of ideas among sectors, thus stimulating economic development (Boschma et al, 2015). The industrial structure of cities change over time and coherence between economic activities is crucial in this respect, as relatedness determines learning potentials between technologies (Neffke, 2009). Intuitively, spillovers occurring between and within sectors constitute a variety in urban and regional economies that can be a supplementary source of economic growth (Raspe and Van Oort, 2004). In the urban dimension, with a similar line of reasoning, a new industry is more likely to enter a city when related to other industries in that city, and an existing industry is more likely to exit a city when it is not, or poorly, related to other industries in that city (Boschma et al, 2015).

There is wide agreement about the positive relationship between variety and the degree of urbanization (Frenken et al, 2004). Indeed, the clustering of economic activity in cities occurs because firms benefit from locating in proximity of one another (Frenken et al, 2004). Here, geographical and institutional proximity between firms in different industries renders the recombination of knowledge and technologies more likely to occur, giving rise to Jacobs externalities. Thus, variety in itself is an extra source of knowledge spillovers, innovation and sustainable economic evolution in urban environments (Frenken et al, 2004).

3.2 Relatedness and Agents

At different geographical dimensions, relatedness reveals itself in the interactions and interdependencies that occur among actors that constitute regional and sub-regional economies. In fact, complementarities between and within spatial units are visible in a variety of agents, influenced and coordinated by the role of Institutions (Murmman, 2003). In this Research, economic sectors assume a key role as determinants of Relatedness among spatial units and, in turn, in explaining the development of economic (spatial) systems. Portfolios of economic activities are investigated through classic indicators such as number of Companies, GDP share and labor force distribution. Considering the spatial distribution and intensity of such indicators, one is able to obtain a comprehensive description of the economic landscape of regional and sub-regional economies, as well as their specialized or diversified evolution. As a matter of fact, firms control and coordinate a wide range of economic activities, becoming significant economic actors whose choices influence economic outcomes (Lundvall, 2002). Specifically, the actions of interdependent firms collectively determine market

behaviour (Whitley, 1987). Thus, firms are seen as “*quasi- autonomous economic agents whose actions are not determined by particular market logics, but together constitute market forces*” (Whitley, p.1, 1987) which subsequently affect the interconnectedness of locational units at different geographical levels. In other words, as significant economic actors, the spatial and operating dynamics of firms are key to the understanding of patterns of resource use and combination. Furthermore, the role of Institutional agents is investigated, seeking to explain the mechanisms behind the location choice of firms and the establishment of Industrial Estates. As further specified in the Methodology section, in this Research, the crucial role of agents is examined with both quantitative and qualitative methods, and their linkages and interactions are argued to be a primary source of investigation for the determination of regional urban configurations.

3.3 Relatedness and Urban structure

Once the relevance of relatedness within the discourse about economic development of spatial units has been clarified, the focus can shift towards the link that exists between relatedness notions and urban structure.

According to classic studies, two main regional structures can be distinguished: monocentric and polycentric. The former is characterized by a strongly hierarchical structure, with one dominant city surrounded by peripheral/dependent cities, while the latter is characterized by “equal” cities that cooperate with each other’s (Burgalassi, 2010). This Research adds a third scenario to the possibilities of urban configurations: the archipelago system. In a rather simplistic way, this configuration can be described as a mix of the monocentric and polycentric scenarios. In fact, in an archipelago system, sub-regional units are not organized according to a particular hierarchy, but the interaction among them is insignificant (van Grunsven, 2019).

In the assessment of such structure, two dimensions – morphological and functional – are considered. The former has been investigated mainly by analyzing the size distribution and the spacing of cities (Meijers, 2008), while the latter by considering the specialization of centers (Kloosterman and Lambregts, 2001) and their mutual interdependencies (de Goei et al., 2008). The theoretical body of our Research is centered around the functional side of polycentrism, where the combined effects of agglomerative and dispersive forces are argued to contribute to model the spatial structure of cities and regions. Consequently, spatial configurations are in between the total concentration of economic activity in one center and uniform distribution over space (Burgalassi, 2010).

Applying such concepts to a locational dimension, past literature assesses that, in the regional context, specialization of centers refers to the structure of economic activities in cities belonging to the regional system. A system is polycentric when its economic structure is characterized by specialization across urban areas, leading to economic complementarities between cities (Kloosterman and Lambregts, 2001). In other words, the economic competition among cities leads to specialization, promoting complementarities. As a result, cities become interdependent. Thus, polycentric regions appear to be the ideal ground for the arise of economies of variety, like those illustrated by Jacobs (Glaeser et al., 1992) at the regional level, while the urban scale would benefit from their specialization and spillovers (Burgalassi, 2010). Accordingly, clustering and specialization of economic activities in centers belonging to a region can be used as indicators of the degree of polycentricity of its regional structure (Kloosterman and Lambregts, 2001).

In this respect, measures of relatedness offer a comprehensive indication of the grade of diversification or

specialization of the spatial (economic) structure of a region, allowing us to enter the discourse regarding the urban structure of the locational unit under analysis. In simple words, relatedness measures (see Methodology Section for details) offer an indication of the sectors' portfolio of regions and cities, allowing us to observe whether they tend to specialize or diversify in economic activities. Moreover, the grade of specialization/diversification may reveal itself to be associated to the pre-existing set of firms in a specific locational unit, underlying the central importance of a path-dependent view of urban and regional development (Boschma and Balland, 2015). Once again, at the regional level, one would expect a polycentric system to be characterized by sufficient levels of variety pertaining to its portfolio of economic activities. On the other hand, when zooming into the sub-components of a regional system, one would expect polycentrism to reveal itself in the economic specialization of sub-regional economic portfolios over time. Intuitively, a monocentric system is reflected in the imbalance between the central node and peripheral nodes of the system. In fact, the central node is expected to be characterized by higher levels of variety, while peripheral ones should be relatively specialized and serve as appendices for the main center. Our third scenario, the archipelago configuration, is expected to reflect variety both at the regional and sub-regional level, excluding clear complementarities among urban entities within a region. In this case, the interactions between nodes are not visible, but are present within them.

This said, nevertheless, both in a regional and urban context, relatedness is expected to be disclosed in the interdependencies between economic activities, whether they indicate a certain level of specialization or diversification over time. By way of explanation, the structural change that characterizes the homogeneity and heterogeneity of industries in a specific locational unit over time cannot be considered as a source of growth and economic development in regions and cities on its own. As a matter of fact, competition is about making the most of local capabilities that are hard to copy elsewhere (Balland et al, 2018). Thus, this does not necessarily mean that regions, in order to survive and prosper, need to specialize in frontline technologies. Instead, they need to tap into specific combinations of local resources that enable them to get a more durable competitive edge. Strictly speaking, relatedness does not simply reflect the diversified structure of locational units, but rather a path-dependent view of it. Relatedness is in fact articulated among two main dimensions: Related Variety and Unrelated Variety. The former describes a portfolio of industries characterized by a relatively high degree of variety, but where industries are poorly related to each other's in terms of knowledge spillovers. The latter, on the other hand, indicates a portfolio of industries characterized by a relatively diverse set of economic sectors, that are also cognitively related to each other's. As already introduced, this cognitive relatedness stays at the base of sustainable development and becomes a crucial attribute for locational entities. Not only a successful regional development requires a diversified economy, but this economy needs to be constructed upon interconnectedness and complementarities within and between its components (Balland et al, 2018).

Intuitively, as Related Variety builds on the interactions and interdependencies between firms and finds its roots in the recombination of knowledge and products, relatedness becomes crucial in explaining the development spurring from localization and agglomeration economies in polycentric regions.

To a noticeable extent, relatedness among non-spatial entities is a required condition for the arise and development of specialization and diversification economies associated with a polycentric or monocentric functional urban configuration (Garcia-López & Muñiz, 2013). Ultimately, this line of reasoning represents the main novelty in our Research, where relatedness measures among industries belonging to a variety of sectors in a delineated spatial unit are argued to be associated with the development of specific urban structures and functional changes over time.

3.4 Diversification and Specialization of spatial entities

The debate on specialization and diversification externalities and their link with economic development is more complicated than it seems. A variety of studies have been conducted in the past and, not surprisingly, an extensive range of results and considerations has emerged. In classic studies, the specialization thesis asserts that regions with specialized production structures tend to be more successful in that industry, as knowledge spills over between similar firms. On the other hand, the diversification thesis argues that diversified structures are more innovative as knowledge spills over between different industries (van der Panne, 2004). The ambiguity of this discourse finds an explanation in the nature of industries under analysis. In other words, for R&D activities, for example, diversification has proven to be a consistent source of improvement, while, for labor-intensive activities, specialization seems to spur economic renewal in regional and urban contexts (Van der Panne, 2004).

Intuitively, the conversation about regional and urban configuration is not as straightforward as one may anticipate, especially when the link between functional structures of spatial entities and their degree of specialization and diversification is explored. The functional approach takes relations between centers into account, stating that a balanced, multidirectional set of relations between urban centers is considered more polycentric. The greater this functional polycentricity, the greater the degree to which a spatial entity is dependent on neighboring units. In fact, building on its own local labor and consumer market, it attracts flows from places outside its own boundaries (Burgers and Meijers, 2012). By way of explanation, in relatedness terms, functional polycentricity in a regional system is reflected in well-developed interdependencies between urban centers. In contrast, if relatedness among non-spatial units is limited within the urban center, the regional system experiences a lower level of functional polycentricity (Burger & Meijers, 2012).

3.5 Relatedness in functional and morphological polycentricity

Relatedness approaches do not only offer explanations on the functional side of polycentrism but can also provide insights on the interaction that exists between this dimension and the morphological structure of regional and urban nuclei. As a matter of fact, substantial differences between the degree of morphological and functional polycentricity are associated with a comparatively large primary center characterized by a stronger local and external orientation, and this disparity increases with the size of the main urban center (Burger & Meijers, 2012). This is explained through the notion that, generally, urban size is positively related with sectoral diversity and a diverse occupational mix, reflected in a larger local labor force and enabling a better balance between labor supply and demand (Jacobs, 1969; Duranton and Puga, 2000). Likewise, larger urban centers exhibit a relatively greater degree of self-sufficiency, propelled by a greater concentration of higher-order functions (Ross, 1992; Glaeser et al., 2001; Markusen and Schrock, 2006).

The relevance of this argumentation suggests that, in order to obtain a comprehensive view over the link that exists between Related variety and polycentricity, a suitable combination of morphological and functional notions is required. This is mostly visible when tapping into the phenomena that are associated with urban configuration, such as what is commonly defined in past literature as “borrowed size” and “agglomeration shadow” (Burger & Meijers, 2012). In fact, it has been stated that *“the rise of ‘city network externalities’, leading to processes of borrowed size as well as the*

rise of agglomeration shadows in networks of cities, provides the missing link between urban dynamics and agglomeration theory” (Meijers et al, p.1, 2016). This argument arises from the notion that regional network connectivity is not always positive as it is reflected into competition and agglomeration shadow between proximate cities (Meijers et al, 2016). The visible outcomes of such competition are articulated as two faces of the same coin. Precisely, a positive influence of network connectivity on the presence of urbanization economies leads to ‘borrowed size’, whereas a negative influence of network connectivity is referred to as ‘agglomeration shadows’ (Meijers et al, 2016).

This Research seeks to shed light on the causes of these two phenomena, aiming at explaining their “arrival” through an approach built on relatedness notions. In a practical way, given the fact that every locational unit possesses a certain portfolio of industries, and taking under consideration that each sector to which industries belong exhibits a certain degree of relatedness to complement or substitute sectors, one may describe dynamics of borrowed size and agglomeration shadows as processes where a spatial entity takes advantage of another one by exploiting its set of capabilities and vice versa.

Generally, network economies represent the rising concept to complement theories of agglomeration economies. Indeed, borrowed size and agglomeration shadows occurring in networks of cities necessitate to reorganize the geographical basics of agglomeration theory when such economies are not confined to agglomerations per se, but can be shared in networks of cities (Meijers et al, 2016).

3.6 Polycentricity framework: The role of Relatedness

In past literature, relatedness theories naturally point out the Network Thinking behind the logic of this mechanism. Thus, relatedness measures are typically utilised to describe the relationship between industries, technologies or products in a variety of locational entities, drawing attention to the network structure of such relationships. It follows that, in network analysis, two components assume central importance: nodes and edges. Developing the discussion along this rationale, nodes and edges represent major points of observation in the disentanglement of polycentric structures.

In the academic discussion, a distinction is formulated between the absolute importance of a center, or its nodality, and the relative importance of a center, or its centrality (Preston 1971, 1975). The former is typically investigated by the size and range of functions a node offers (Lukermann, 1966), while the latter is ascribed to the provision of goods, services and jobs in excess of those demanded by the node’s population (Ullman, 1941; Preston 1971; Barton, 1978; Marshall, 1989). Such distinction refers to the concept expressing that the importance of a center must be not only based on its size, but also on the settlement as an agglomeration and central place, providing functions and services to neighboring centers (Christaller, 1933). Thus, it is appropriate to distinct the external importance from the local importance of a center (Burger & Meijers, 2012).

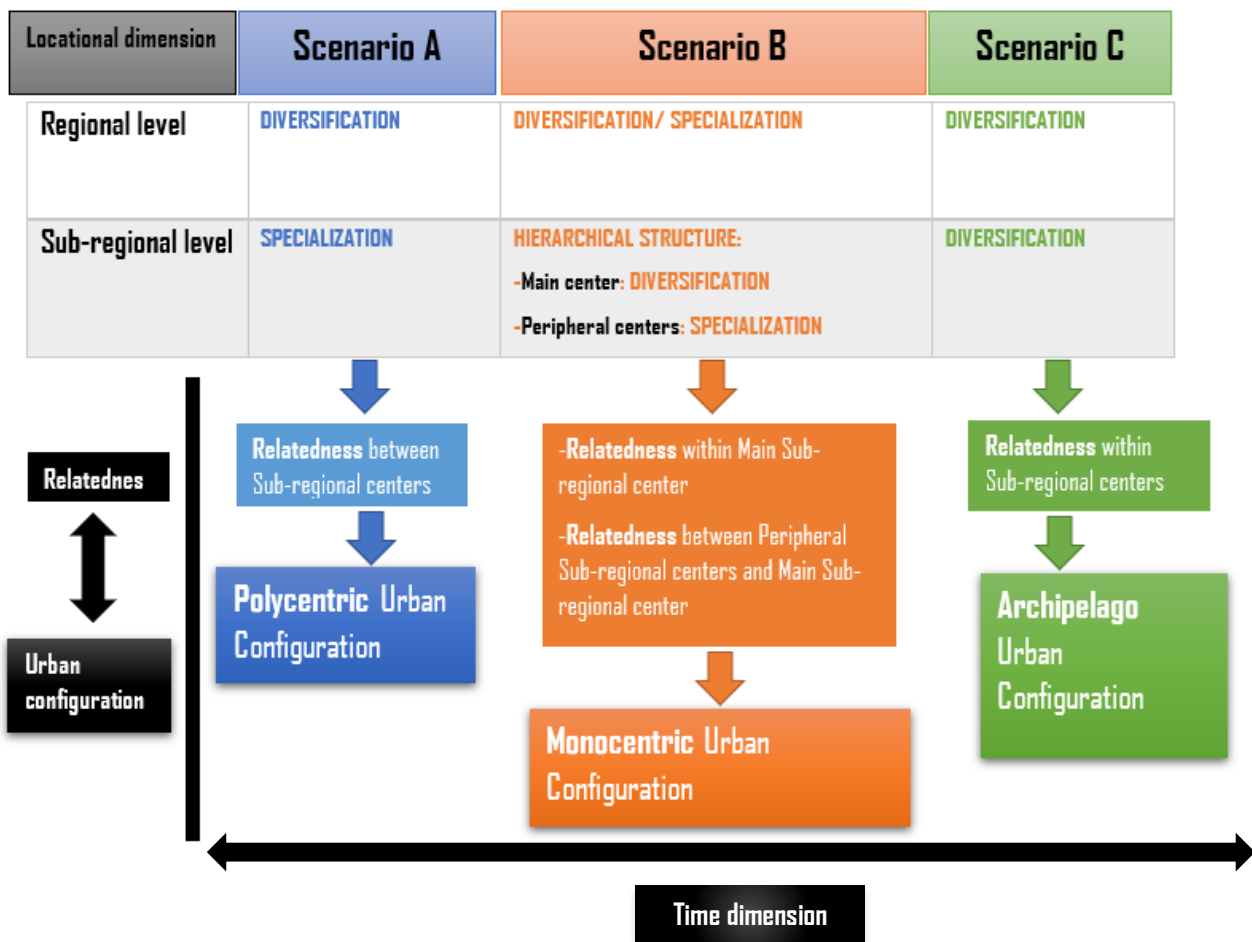
This argument is easily identifiable in the two above-mentioned dimensions that constitute the analysis of urban configurations, namely morphological and functional. In fact, whether the morphological dimension is widely utilised to depict the nodality of cities in a regional framework, relatedness is argued to be a comprehensive indicator of cities’ centrality.

To conclude, in an attempt to link urban structure to relatedness notions, this Research points out the descriptive and analytical nature of relatedness measures. On one hand, relatedness would contribute to unravel specialization and

diversification dynamics in a regional framework. On the other hand, the network thinking behind it would be utilized to shed light on the interdependencies of cities in this same framework, adding a considerable contribution to the analysis of urban spatial (economic) configurations.

3.7 Model conceptualization

The theoretical framework constructed for this Research is summarized in the following Conceptual model. Through this schematic overview, the reader is provided with a clear description of the expected dynamics characterizing the feasible settings in the locational unit under analysis. Specifically, the Polycentric, Monocentric and Archipelago urban structures are unraveled and linked to dynamics of diversification/specialization and interdependencies, reflected in relatedness notions. The three observable structures are depicted as scenarios, namely A, B, and C. For each one of them, the conditions at the regional and sub-regional level in terms of sectoral composition are specified. Also, the level of interconnectedness is explained through the concept of relatedness, expressed either between or within Sub-regional units.



As testified by the depicted Time dimension, the model is adapted to the dynamic character featuring our Research. In fact, as the analysis is conducted on several time periods, it is crucial to recognize that the urban configuration of the region under analysis might have experienced structural and functional changes over time. In a rather simplistic way, the

urban structure of Perak may appear as monocentric in the 80's, characterized by specialized peripheral centers surrounding a diversified main center, and subsequently evolve as a polycentric system in the 90's. Consequently, relatedness measures may be identified between or within sub-regional units depending on the time period under analysis, unravelling path-dependent dynamics.

4. Methodology

The multiple datasets created for the investigation conducted in this Research are retrieved from several sources, both quantitative and qualitative. The quantitative information is obtained mainly from the Commission of Companies of Malaysia (SSM, 2019) and the Department of Statistics of Malaysia (DOSM, 2019), as well as from a series of documents produced by ThinkCity and the Government of Malaysia (Perak Baseline Study, Negeri Perak 2020 and 2040, CitiesProfile 2016). These sources allow us to retrieve a satisfactory amount of raw data translated into suitable indicators for the spatial economic structure of Perak. Among others, data includes employment statistics, GDP share per sector, number of establishments and number of incorporated companies. On a qualitative side, interviews have been carried out with those who are identified as main players in the Perak regional economy. In fact, qualitative information is retrieved from some of the major Companies in the region in the Agriculture, Manufacturing, Construction and Services sectors, as well as from main Governmental bodies involved into the decision-making process in relation to location choice of Industrial Estates and their composition.

Also, the data was collected to fulfill the need to obtain comprehensive spatial economic indicators at various locational dimensions. In fact, following the Theoretical Framework chapter of this Research, national, regional and sub-regional figures are utilised to offer an inclusive overview of industries' dynamics that shape the regional and urban structure of Perak. The choice to depict the national context in which Perak is positioned already presents a reliable overview of its regional economy and competitive advantages and disadvantages benchmarked to other regions in Peninsular Malaysia. Parallely, the analysis conducted at the regional and sub-regional level represents the main contribution in the attempt to investigate the specialization, diversification and relatedness measures among industries that influence the functional urban configuration of Perak.

Thirdly, it is needed to specify that the data collected does not undervalue the importance of an investigation on the path-dependence processes observable among the above-mentioned spatial dimensions over time. In fact, to present the reader with a wide-ranging outline of relatedness and functional structure dynamics, the analysis in the Research is conducted on multiple time periods: 1987, 1997, 2007 and 2018. The reason behind this choice is also dictated by the fact that structural changes and relatedness dynamics become more evident once the time frame is enlarged, as exemplified by numerous studies on the issue (Boschma and Balland, 2014).

It follows a detailed description of the methodology for every specific indicator. For each figure, the analytical methods, time frame and spatial dimensions are addressed. The clarification of our methodology follows a hierarchical structure, starting from the broader geographical dimension, Peninsular Malaysia, and then zooming into the region of Perak, its districts, main cities and towns. Subsequent to this detailed description, the methodology focuses on explaining the mechanisms behind relatedness computations. A separate sub-chapter is produced, given the central importance of relatedness, so to offer the reader with a clearer impression of the role that relatedness plays in determining the effectivity of specialization and diversification dynamics, as well as its link with the urban configuration of locational entities. To conclude, a description of qualitative sources and methods utilized completes the Data and Methodology chapter.

4.1 Quantitative analytical methods

4.1.1 Regional level

The analysis of the relationship between industries' relatedness and the functional urban structure of Perak starts by describing the characteristics of the region in analysis, utilizing other regions as benchmarks to evaluate the development and current positioning of the investigated spatial unit. On a general note, three indicators are utilized to describe Perak's positioning in the economy of Peninsular Malaysia over time: (1) GDP share by kind of economic activity per State for the years 2010 and 2016, retrieved from DOSM, (2) Employed persons by industry per State for the years 1987, 1997, 2007 and 2017, retrieved from DOSM, (3) Incorporated companies per sector in Perak for the years 1987, 1997, 2007 and 2018, retrieved from SSM.

GDP Share

Regarding the first indicator listed, GDP share per sector, the dataset contains the GDP for every State in Peninsular Malaysia by kind of economic activity (see Appendix 2 for Industry classification) at constant 2010 Prices, expressed in RM Million. This is used to generate a summary table in which the growth per economic activity in every State is showed. To facilitate the comprehension of the data showed, sunburst graphs are produced for the year 2010 and 2016. In each one of these graphs, the total area is divided into percentages that indicate the relative GDP share of each State to the National total in a particular economic activity. Thus, by comparing the graphs from the two different time periods, one is able to assess the change in relative competitive advantages (RCA) of every State in terms of GDP. Secondly, to offer a complete view of the State of Perak, two radar graphs are produced, each depicting the comparison between Perak and the average for Peninsular Malaysia, in 2010 and 2016. Furthermore, the GDP values at the State level are transformed into two bar graphs, relative to 2010 and 2016, that illustrate per capita values utilizing population statistics per State (DOSM, 2016). This step allows us to have a better estimation of the relative weight of each State in terms of GDP share because of the large differences in terms of population size over time. Thirdly, the analysis continues with an in-depth description of GDP share distribution for Perak only. In this respect, a column graph divided by economic activity for the years 2010, 2011, 2012, 2013, 2014, 2015 and 2016 is produced, to show the annual share in every sector for the region in analysis. To have a more precise interpretation in terms of unit scale, a line graph is generated for every economic activity. After transforming GDP values from absolute to percentage values, a sunburst graph for the years 2010 to 2016 is produced for Perak, so to observe the change into the composition of its economic structure based on the division among economic activities.

Labor force distribution

Moving on to the second indicator, Labour force distribution, the dataset contains the number of employed persons divided by industry (see Appendix 3 for Industry classification) from 1982 to 2017 for every State in Peninsular Malaysia, expressed in thousands. This is used to compute percentage values to indicate the relative share of every State in a

particular industry in 2017, so to assess the grade of diversification and specialization of every State in analysis. From these values, two types of figures are produced. The first one is depicted in form of a sunburst graph for every State, in which the percentage distribution of the labor force in 2017 across industries is observable. The second one, in the form of column graphs, indicates the percentage of labor force employed per industry in every State in the year 2017. In this case, it has to be noted that the percentages reported refer to the State and not to Peninsular Malaysia, meaning that the values indicate the relative share of a particular industry in that specific State, in terms of employment, to account for population disproportions. Zooming into Perak, four radar graphs for the years 1987, 1997, 2007 and 2017 depicting a comparison between the region and the average for Peninsular Malaysia are presented. These are used to estimate the relative competitive advantage of Perak in different time periods, in terms of workforce. After producing the graphs, values are translated into two maps that indicate the distribution of industries across space in Peninsular Malaysia. Here, the color of circles in the map refers to a specific sector, while their size reflects the relative importance of that sector in the specific region. The two maps illustrate employment distribution in 1987 and 2017, so to offer a visual comparison of the spatial (economic) development at the national and regional level. As a final remark, it has to be specified that the industries division utilised in the analysis of the labor force composition reflect the categories of economic activities treated to express the GDP share per state (see Appendix 2 and Appendix 3). Thus, the two measures can be compared to assess similarities and differences between the two indicators.

For this second indicator, the first relatedness measures are computed. Utilizing Rstudio, and specifically the EconGeo package coded by Prof. Pierre-Alexandre Balland, the percentages of labor distribution across industries per State in Peninsular Malaysia are used to compute the relative competitive advantage of each one of the locational units under analysis. The RCA is analyzed across the four above-mentioned time periods (1987-2017), to obtain an analysis of the changes that occurred in Peninsular Malaysia in terms of employment over time. Interestingly, other than assessing the presence of path-dependence in the spatial (economic) structure of States, the latest results, relative to 2017, are used to produce a prediction of the development of the spatial (economic) system of Perak. To validate this finding, we compare the prediction to information based on Perak 2020 and Perak 2040 regional plans, observing similarities in terms of economic activities that the State is planning to emphasize in the upcoming years.

Incorporated Companies

Regarding the third and last indicator at the Regional level, the dataset obtained from SSM contains the number of Companies incorporated in Perak in the years 1987, 1997, 2007 and 2018, divided per economic sector (see Appendix 4 for Industry classification). Specifically, the dataset presents an internal division between three categories, namely “Active companies”, “Expired Companies” and “Winding up Companies”. This allow us to produce multiple area graphs in which the number of active, expired and winding up Companies in Perak from 1987 to 2018 is depicted. With these measures, it is possible to assess the dominant sector in terms of incorporated Companies for every one of the selected years in Perak. As already mentioned, this dataset does not indicate the overall number of Companies in the region, but the number of new Companies registered in that specific year. Therefore, this does not offer a complete overview of the spatial (economic) structure of the region in absolute terms. Nevertheless, this indicator is used to show the fastest growing

sectors in the region, and it is considered a very comprehensive proxy value for the composition of the Industry Space in Perak as a whole.

4.1.2 District level

The analysis of the relationship between industries' composition and the functional urban structure of Perak continues by describing the characteristics of the region in analysis, utilizing its sub-units, named as districts, to evaluate their development and current positioning. On a general note, two indicators are utilized to describe Perak's districts positioning in the regional economy over time: (1) Number of establishments per sector in 2017, retrieved from DOSM, (2) Incorporated Companies per sector for the years 1987, 1997, 2007 and 2018, retrieved from SSM.

Number of Establishments

Regarding the first indicator, the number of establishments per sector, the dataset contains the total number of establishments in Perak, divided per district. Establishments are divided into five main categories, namely Agriculture, Manufacturing, Construction, Mining and Quarrying, and Services. The information in the dataset, provided by DOSM, refers to 2017 and it is an estimation based on the 2016 economic census. Firstly, data is transformed into an area graph to show, in a hierarchical order, the districts to which the highest number of establishments belong to. Also, to give the reader a better representation of the spatial (economic) distribution of activities in Perak, the same graph is adjusted considering the population size of each district, based on data retrieved from WorldPopulation (2019). The result is an area graph on which the total number of establishments per capita in every district is projected. The next step involves the realization of five bar graphs, one per sector, in which the number of establishments per district is shown. Following the same line of reasoning utilised at the State level, this allows us to observe the relative competitive advantage of every district in Perak, in terms of number of establishments. Intuitively, this computation at the district level gives a more precise indication of the spatial (economic) evolution of Perak and points out the geographical distribution of employment and the number of incorporated firms analyzed at the regional level. Once again, to control for the different population size across districts, the number of establishments per district is transformed into per capita values, utilizing population data retrieved from DOSM and WorldPopulation.

Incorporated Companies

Regarding the second indicator, the number of incorporated Companies, the dataset obtained from SSM contains the number of Companies incorporated in Perak's districts in the years 1987, 1997, 2007 and 2018, divided per economic sector (see Appendix 4 for Industry classification). With this information, a matrix table indicating the number of incorporated firms from 1987 to 2018 in every sector for each district in Perak is produced. It follows a series of column graphs dedicated to specific districts in Perak, in which the growth in the number of incorporated Companies per sector from 1987 to 2018 is illustrated. Also, analyzing the data from a different angle, area graphs per sector are produced to show and compare the growth in each district. These computations are then utilised to produce one of the most interesting illustrations of the Research: four radar graphs, relative to 1987, 1997, 2007 and 2018, for every district in

Perak, where the number of incorporated Companies in that specific year is projected on the average of incorporated Companies in the State. These graphs, similarly to the ones realised at the National and Regional level, allow us to observe the relative competitive advantage of each district in Perak over a thirty years period. Intuitively, this gives a preliminary hint about the role of path-dependence and the change in the spatial (economic) structure of sub-regional locational units in the Malaysian State, allowing us to enter the discourse on the link that exists between industries' relatedness and urban configuration.

These results are the starting point for the realization of Related Variety measures at the district level. From an adjacency matrix of sectoral composition, Relatedness Density for every sector in each of the districts of Perak is computed, giving a precise overview of the spatial (economic) distribution of incorporated Companies per year in every locational unit, as well as sectors' relations with the current portfolio of industries in each district. Next, the RCA of every district is computed. Combining these two measures, we are able to assess the grade of path-dependence between time periods. In other words, it is possible to estimate the percentage of newly incorporated Companies in a specific year that were characterized by an above-average level of Relatedness Density in the given district in the precedent time period. Also, following the same line of reasoning utilised at the Regional level, it is possible to estimate the future composition of industries' portfolios in each district by observing values of Relatedness Density in 2018. Based on path-dependence estimations computed for previous time periods, one is able to assess the accuracy of such prediction. Combining the measures for specific districts together, two indexes per time period are computed, namely Diversity index and Ubiquity index. In a rather simplistic way, the Diversity index, expressed in form of a radar graph, indicates the relative grade of diversity of each district in term of newly incorporated companies in a given year. If a district possesses a portfolio of Companies in a wide range of economic sectors, its Diversity index will be higher. Conversely, if a district presents a portfolio of industries relatively specialized in a specific economic sector, its Diversity index will be lower. On the other hand, the Ubiquity index indicates the most widespread economic sector among districts in a specific year. If a specific economic sector is found in a relatively large number of districts, its Ubiquity index will be higher. On the contrary, if companies belonging to a specific economic sector are relatively concentrated in a few districts, its Ubiquity index will be lower.

The last step for the analysis of the sub-regional dimension in Perak is constructed around the evaluation of Economic Corridors. The investigation considers the policy put forward by Negeri Perak 2020 plan, in which a number of districts are grouped together, aiming at leveraging their relative capabilities and advantages to constitute a more competitive and efficient spatial (economic) system. Therefore, the analysis takes the computed RCA values at the district level for the year 2018 and looks at possible complementarities of industries belonging to the same Economic Corridor. By doing this, one is able to assess the efficiency of such policy from a relatedness perspective, proving in an analytical way the feasibility of these clusters and their potential in terms of economic development and sustainability.

4.1.3 City level

The analysis of the relationship between industries' distribution and the functional urban structure of Perak continues by describing the characteristics of its main cities and towns, to evaluate their development and current positioning. On a general note, two indicators are utilized to describe Perak's districts positioning in the regional economy over time:

(1)Specialization of cities, retrieved from Perak Baseline study, Negeri Perak 2020 & 2014, City Profiles 2016, (2) Incorporated companies per sector for the years 1987, 1997, 2007 and 2018, retrieved from SSM.

Economic Specialization

Regarding the first indicator, the economic specialization of cities in Perak, the information contained in three different documents is combined to overcome the relative scarcity of data at the city level. In fact, with a comprehensive analysis of documents produced in past years, we are able in this Research to construct a table expressing the relative specialization of the main urban centers in the Perak region. In other words, it is possible to depict the economic sectors (see Appendix 5 for Industry classification) in which every city in the so-called Perak Diamond has a relative advantage. Even though this method suffers from several limitations, such as the imprecision derived from the actual size of each sector in cities, the study proceeds by producing a visual representation of the results obtained. Firstly, sectors are drawn on a map as colored bubbles and are placed in the specific location in which they are present. Their color is attributable to the sector, while their size indicates the relative weight of the sector in the specific city. Secondly, after computing relatedness measures across sectors, relatedness indexes are utilised to depict the links between cities, based on sectors' complementarities. From this, a discussion on the phenomena of borrowed size and agglomeration shadow is presented in the Research.

Incorporated Companies

Regarding the second indicator, the number of incorporated Companies, the dataset obtained from SSM contains the number of Companies incorporated in a range of Perak's cities in the years 1987, 1997, 2007 and 2018, divided per economic sector (see Appendix 4 for Industry classification). With this information, a matrix table indicating the number of incorporated firms from 1987 to 2018 in every sector for each city in Perak is produced. It follows a series of area graphs per sector, in which the number of incorporated Companies in every city is observable. This step is repeated for each one of the four time periods in analysis, so to offer the reader a more inclusive overview of the changing dynamics that characterize the spatial (economic) system of cities and towns in Perak. Next, the analysis focuses on the visual representation of this economic system. Several maps are produced, each one depicting the distribution of incorporated Companies in cities in 1987, 1997, 2007 and 2018. These maps are compared to the above-mentioned specialization maps, in order to spot similarities and further verify the findings.

Utilizing the visual analysis and relatedness measures developed at the district level, a discussion of results gives a comprehensive interpretation of the interaction between industries' relatedness and urban configuration at different locational dimensions.

4.1.4 Relatedness Measures: an in-depth analysis

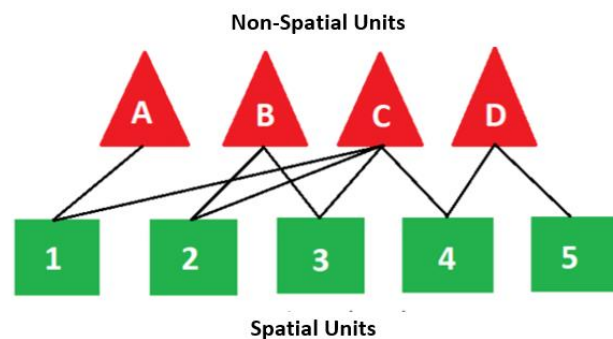
In this sub-section of the Methodology chapter, the mechanisms that act behind relatedness notions are specified. While the methodology followed for the realization of most of the graphs and figures retrieved from SSM and DOSM is quite straightforward, the additional computations utilised for relatedness measures are more complicated. Thus, this sub-chapter is specifically built to give a more in-depth explanation of the methods applied to investigate the labor force

distribution at the national level, the number of incorporated Companies at the district and city level, and the industry specialization at the city level.

In this respect, the methodology followed in this study is constructed upon the concept of Network Thinking, an intellectual approach that shifts the unit of analysis from individuals and their attributes to the structure of their relationships (Wellman, 1997). Indeed, Network analysis provides a set of concepts and methods to efficiently describe and model patterns of ties linking elements of economic systems (Hanneman and Riddle, 2005). When applied to a locational dimension, a network-based view of regions and cities implies an accumulation of knowledge that becomes increasingly complex. Consequently, firms and individuals specialize and narrow their expertise. Since knowledge is increasingly distributed across organizations, it develops a need for collaboration, recombination and coordination. This process is argued to be the foundation of growth in knowledge-based urban economies (Gutzmer, 2015). Therefore, this paper aims at applying Network Thinking concepts and methods to industries' networks in the Perak region. To answer our Research Questions in the most suitable way, a specific Workflow Algorithm is followed using R (Rstudio, 2015), a programming language and software environment for statistical computing and graphics. In Rstudio, the program's interface, an Economic Geography package is downloaded to compute common economic and geographical measures (Balland, 2017). It follows a detailed description of the underscored steps, applied to the selected indicators.

1. Spatial systems as a 2-mode network

The Spatial System in this project is determined by the districts and cities located in Perak and is characterized by a unique portfolio of industries. To be seen as a 2-mode network, a distinction between spatial units and non-spatial units is needed. In this case, cities, or districts, are defined as spatial units, while economic sectors are defined as non-spatial units. Each spatial unit is connected to one or multiple non-spatial units, indicating the presence of certain sectors in a district or city. In turn, each sector comprises a certain number of companies/employed persons, depending on the indicator used. From this 2-mode network, an adjacency matrix is created, where Spatial units are listed on the vertical axis and non-spatial units are on the horizontal axis. The value in each cell indicates the number of firms/employed persons in a specific economic sector in a city/district.



	I1	I2	I3	I4
R1	1	1	4	0
R2	5	0	2	6
R3	8	3	0	8
R4	0	5	9	2

Where:

- o R=region/district/city
- o I=industry/economic sector

The value in each cell indicates the number of *firms/employed persons* in a region for a particular industry.

2. Compute co-occurrences between Non-spatial entities

This step is performed to observe the number of times that two non-spatial units co-occur in the same spatial unit. In other words, it is investigated the number of times that two sectors co-exist in cities or districts in Perak. To do so, the matrix obtained in the first step is multiplied by its transpose, resulting in a Co-occurrences matrix with non-spatial units both on the horizontal and vertical axis, where each cell contains the number of co-occurrences between two sectors.

	I1	I2	I3	I4
I1	0	2	2	2
I2	2	0	2	2
I3	2	2	0	2
I4	2	2	2	0

3. Compute Relatedness between Non-spatial entities

Even though two sectors may co-occur numerous times, this does not automatically imply relatedness. In fact, the co-occurrence of two non-spatial units might be determined by chance, with no clear indication of a functional relationship between the two (Balland, 2017). In order to overcome this issue, measures of co-occurrences are normalised. To do so, the ratio between the observed co-occurrences and the expected co-occurrences is computed. When the ratio is larger than 1, the two economic sectors are said to be related.

$$\text{if } \frac{\text{observed co-occurrences}}{\text{expected co-occurrences}} > 1 \text{ --> related}$$

	I1	I2	I3	I4
I1	0	1	0	1
I2	1	0	1	0
I3	0	1	0	0
I4	1	0	0	0

These calculations result in another adjacency matrix, similar to the Co-occurrences one. Once again, Non-spatial units are on both axes, but in this matrix the value in the cells is either 0 or 1, indicating relatedness between sectors at the regional level.

4. Compute Relatedness Density between Spatial units and Non-spatial units

In the fourth step of the Workflow algorithm, the Density Index is computed using the following equation (Function 1). In general, the Density Index measures the relatedness of a new technology to the pre-existing set of technologies produced in a particular spatial unit (Balland, 2017). In this paper, this measure indicates the relatedness of a new sector to the pre-existing set of sectors in each district or city.

Function.1

$$D_{i,c,t} = \frac{\sum_i x_i \varphi_{ij}}{\sum_j \varphi_{ij}} \times 100$$

The density around a given sector i in the city c in time t is computed from the relatedness of sector i to the portfolio of sectors in city c in time t , divided by the sum of relatedness of sector i to all the other sectors in Perak in time t . By construction, the Relatedness Density variable lies between 0 % and 100 % (Balland, 2017). The result is a matrix with Spatial units on the vertical axis and Non-spatial units on the horizontal line. The values in the cells indicate the level of relatedness between the sector in the specific column and all the other sectors present in the city or district's portfolio on the selected row.

5. Compute the Diversity and Ubiquity Index

The fifth step of the workflow algorithm adds on the findings derived from the first four. By computing the Diversity index, one is able to derive a simple measure of diversity of locational units by counting the number of industries in which a spatial entity has a relative competitive advantage ($RCA > 1$) from regions-industries (incidence) matrices. If the portfolio of industries in a specific spatial unit present a high variety in terms of sectoral composition, its Diversity index will be high, and vice versa. On the other hand, the Ubiquity's function computes a simple measure of ubiquity of industries by counting the number of spatial units in which an industry can be found ($RCA > 1$) from regions-industries (incidence) matrices.

This detailed description of relatedness measures is key as it is used to unravel economic complementarities between cities, as well as inter-firm connectivity. In particular, the Relatedness Density values are utilised to observe the economic sectors to which a city, or district, is cognitively related. Thus, if a particular sector is not found in a city, and it shows a cognitive relatedness to the city's portfolio of industries, then this sector is considered as complement to the current industrial portfolio of this city. From this line of reasoning, this city is expected to be interconnected with proximate cities that possess this particular sector in their industrial portfolio.

Spatial analysis

The methodology described is applied to three different indicators: (1) the labor force distribution at the national level, (2) the number of incorporated Companies at the district and city level, and (3) the industry specialization at the city level. In the case of the labor force distribution, the spatial units are identified as States in Peninsular Malaysia, while the non-spatial units are represented by the number of persons employed in a vast range of economic activities. For the number of incorporated Companies, the non-spatial units are identified as newly incorporated Companies in a considerable array of economic sectors, while spatial units are either districts or cities. In the case of industry specialization, spatial entities are the main cities that constitute the so-called Perak Diamond, while non-spatial units are the sectors in which these cities are considered to be specialized in. As already mentioned, after setting geographical boundaries, a time variable is introduced, used to adapt the dataset to the dynamic perspective on knowledge networking and proximity (Boschma and Balland, 2014). In fact, the notion of Related Variety is characterized by a spatial and economic evolution over time, and this implies a use of multiple datasets. To observe the development of urban and regional networks, data relative to the location of non-spatial units in 1987, 1997, 2007 and 2018 is collected, recording entries and exits.

4.2 Qualitative analytical methods

4.2.1 Firm level

The multidisciplinary nature of this Research is reflected in the diversity of methods utilised to construct an inclusive overview of the Perak regional system. As a matter of fact, alongside quantitative data and methods, qualitative interviews are carried out with those that are identified among the most important actors in the economic system of Perak. Specifically, following the Theoretical framework of the Research, Companies and Governmental bodies are selected to present a detailed analysis of the urban configuration of the region.

Firstly, the objective is to verify the quantitative findings of the Research by investigating the structure of Companies in terms of value chain and investments' patterns. Explicitly, firms in the Agriculture, Manufacturing, Transport and Service sectors are questioned about their location choice and their interconnectedness with other Companies or locations in the region, their suppliers, and their main sources of demand within the region. Companies are identified based on the latest investment statistics available (retrieved from Luka Raaijmakers' Research), provided by the Malaysian Investment Development Authority (MIDA, 2019). This is used as a validation of the hypothesized relatedness links at the district and city level, in an attempt to unravel functional complementarities in Perak. Specifically, representatives' insights from Kuala Lumpur Kepong Berhad, Malayan Flour Mills, Finisar Malaysia Sdn Bhd, Megah Transport Sdn Bhd and Ecoauto Assembly Plant Sdn Bhd are utilised to construct this chapter of the Research.

Secondly, Governmental agencies are interviewed to obtain information from an Institutional angle. Such evidence is utilized to unravel similarities and differences between views from the private and public sector, identifying flaws in the planning of the spatial economic development of Perak. Specifically, an extensive interview is carried out with Perbadanan Kemajuan Negeri Perak (PKNP, 2019), the investment arm of the district Government, in regard to Land distribution and Industrial Estates' composition.

It follows a schematic overview of the agents interviewed

<i>NAME OF THE AGENT</i>	<i>CORE BUSINESS/ FUNCTION</i>	<i>LOCATION</i>	<i>REPRESENTATIVE</i>
Kuala Lumpur Kepong Berhad	Pal Oil Plantations (Agriculture)	Ipoh [Kinta, Perak]	Dato' Lee Hau Hian [Director, Member of Remuneration Committee, Member of Nomination Committee]
Malayan Flour Mills	Food Manufacturing	Lumut [Manjung, Perak]	Yong Yee Wan [Plant Manager]
Finisar Malaysia Sdn Bhd	Electronics & Electrical Products	Kinta Free Industrial Zone [Kinta, Perak]	William Yu [Shipping Manager]
Megah Transport Sdn Bhd	Transportation Services	Kamunting Industrial Estate [Larut-Matang-Selama, Perak]	Dato'Lee Aik Kheow [Managing director]
Ecoauto Assembly Plant Sdn Bhd	Assembly of vehicles and Transport Equipment	Kamunting Industrial Estate [Larut-Matang-Selama, Perak]	Mr. Lau [Executive director]
PKNP	Investment arm of district Government, involved in the establishment of Industrial Estates in Perak	Ipoh [Kinta, Perak]	Goradial Singh Ban Singh [Manager]

5. Analysis of specialization and diversification dynamics

The Research unites interesting results concerning the link between the selected economic indicators, relatedness and urban configuration in Perak at different geographical levels. To facilitate the reader in the comprehension of such outcomes, this section of the study presents our findings following the same line of reasoning adopted in the Methodology chapter of the Research. Firstly, the results at the regional level are presented, followed by sub-regional ones. Specifically, the results obtained from the quantitative analysis anticipate the validation of measures achieved through the qualitative information retrieved from interviews with main Companies and Governmental agencies operating in the region.

5.1 Quantitative analysis

5.1.1 Regional level

GDP Share

Firstly, the results obtained from the investigation of GDP share per sector at the State level are presented. As anticipated in the Methodology section, sunburst graphs are produced to assess which States can be recognized as front-runners in each kind of economic activity, in 2010 and in 2016 (see Appendix 6 for complete representation). Here, a selection is made to present only those sectors in which Perak results as a leader, meaning that the State is found among the top five States in terms of GDP share per economic activity (Figure 7).

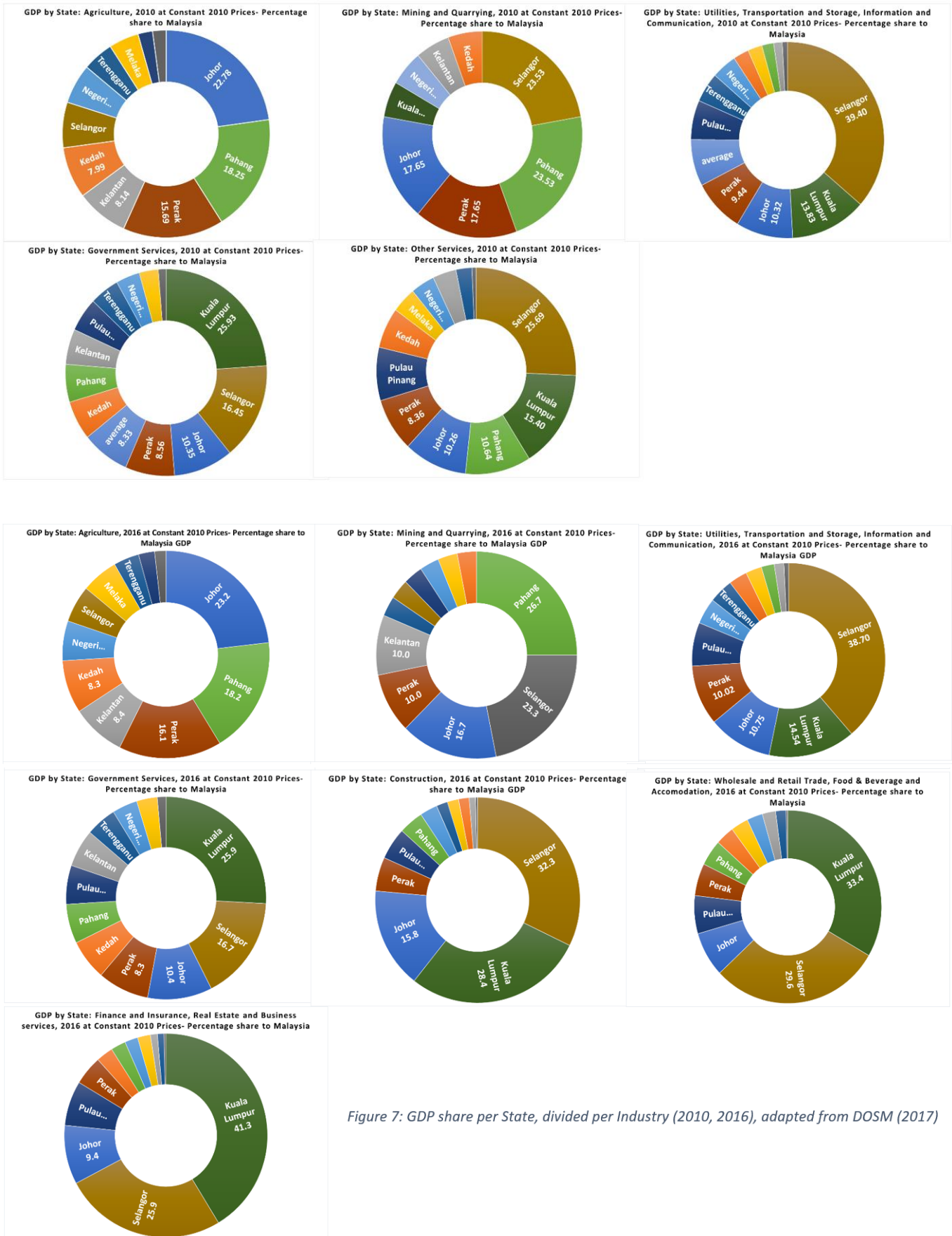


Figure 7: GDP share per State, divided per Industry (2010, 2016), adapted from DOSM (2017)

As visible from the sunburst graphs, in 2010, Perak results to be in the top five States in terms of GDP share in the sectors of Agriculture; Mining and Quarrying; Utilities, Transportation and Storage; Information and Communication; Government Services; Other Services. On the other hand, in 2016, Perak results in the top five in a larger pool of economic activities. In fact, compared to 2010, Perak loses its position only in terms of Other services, while gains a higher percentage share in the Construction; Wholesale and Retail Trade; Food & Beverage and Accommodation; Finance and Insurance, Real Estate and Business Services. This change, over a five years period, gives a preliminary hint about the process of development and diversification taking place in the State of Perak. From these results, it appears that the region is indeed in the process of shifting from a highly specialized economy, historically related to the Agriculture and Mining Sector, to a more diversified one, following the global trend towards a smarter economy based on high-end activities, such as financial and insurance sectors.

To enrich the analysis, the values obtained are adjusted according to the population size of every State in 2017 (DOSM, 2017), to account for population differences (Figure 8).

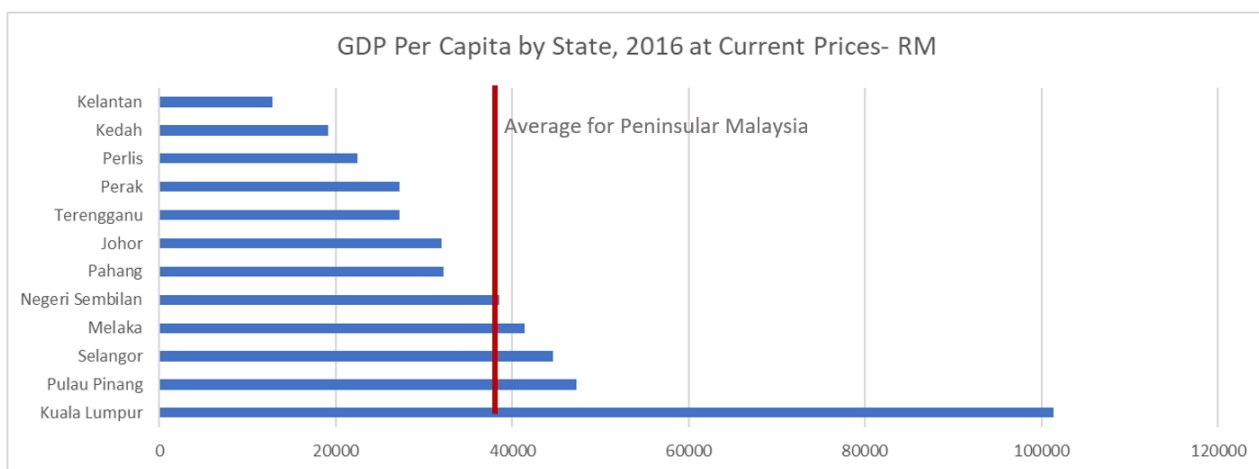


Figure 8: GDP per capita, divided per State (2016), adapted from DOSM (2017)

As visible from the graph, where GDP per capita is presented in a hierarchical order, Perak is amongst the States in the lower half of the list, characterized by a degree of GDP per capita below the Average for Peninsular Malaysia. This information indicates that, even if the region is diversifying in a larger pool of economic activities, its position, when benchmarked to other States in Peninsular Malaysia, underlines the difficulty that Perak is encountering in this transition.

Even though GDP share per capita is a good indicator of the State's economic performance, the Research proceeds by zooming into the components of the overall GDP. In fact, in order to obtain a clearer view of Perak's advantages in terms of GDP generation and the changes in these dynamics over time, two radar graphs are presented, each reflecting the relative competitive advantage of the region in 2010 and 2016, where GDP shares for specific sectors are depicted. In these graphs, the difference, positive or negative, between Perak and the average of Peninsular Malaysia is projected, resulting in a visual representation of the grade of diversification of the spatial unit under analysis (Figure 9).

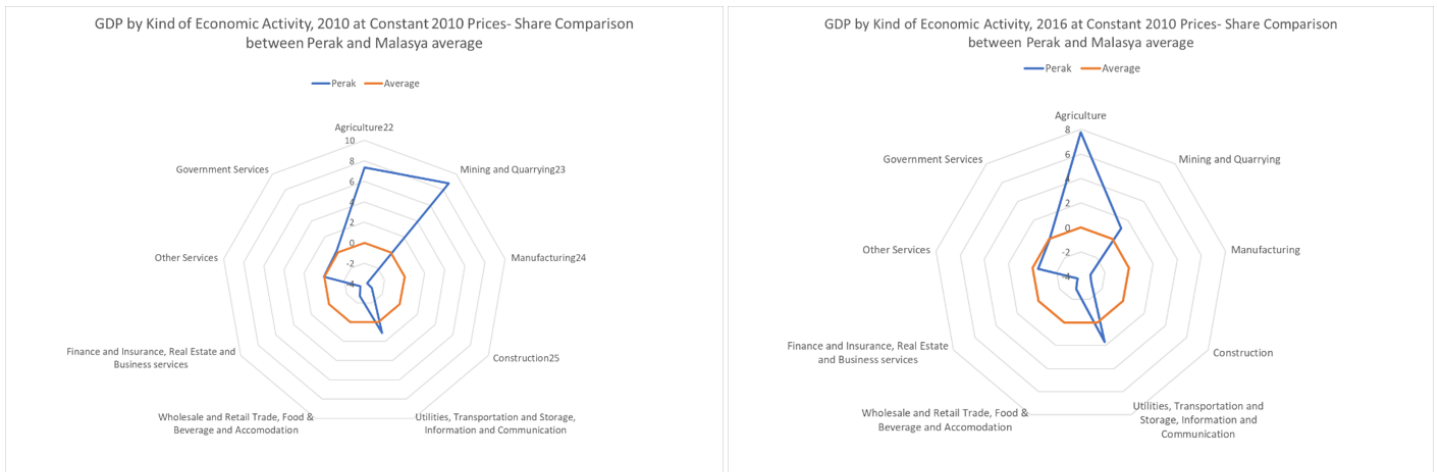


Figure 9: GDP by Industry (2010, 2016) in Perak, adapted from DOSM (2017)

As visible from the two figures, the structure of the economy of Perak in terms of GDP share, even if not changing drastically, presents some differences between 2010 and 2016. As already anticipated, growth is registered in the sectors of Construction; Wholesale and Retail Trade; Food & Beverage and Accommodation; Finance and Insurance, Real Estate and Business Services. Interestingly, the decrease of Mining and Quarrying in favor to Utilities, Transportation and Storage, Information and Communication observed when comparing the two graphs validate the crisis of the Mining sector on one hand, and the rise of the ICT sector on the other one, reflecting global trends that progressively focalize on services rather than on the exploitation of natural resources.

The radar graphs are accompanied by the following figured, in which the unaffected result is visible by projecting the growth per economic activity and the annual percentage change in Perak (Figure 10).

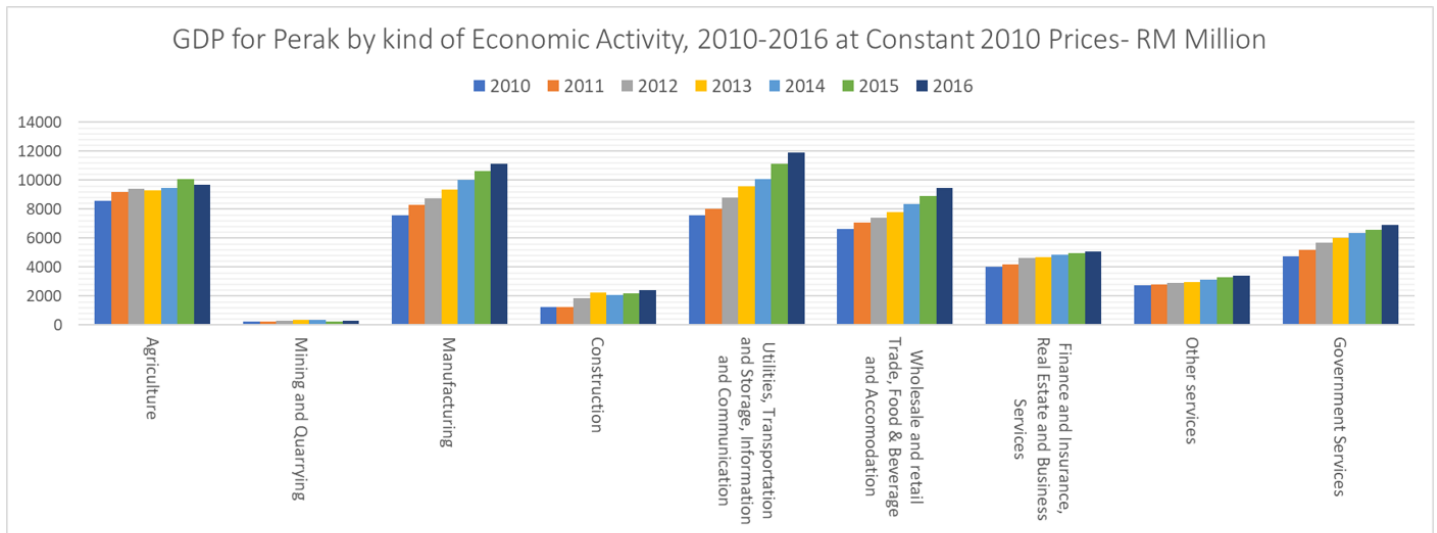


Figure 10: GDP in Perak by Industry, 2010-2016, adapted from DOSM (2017)

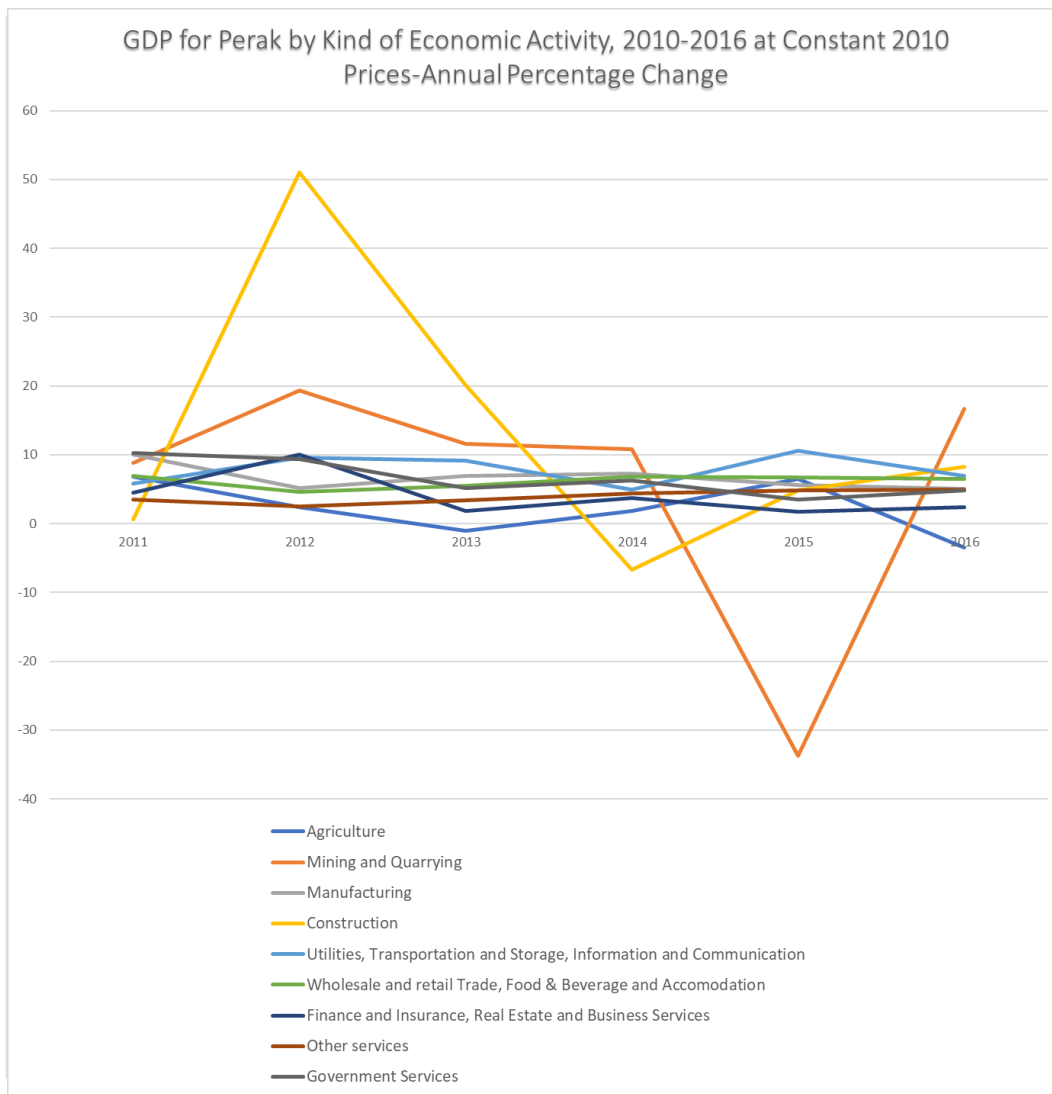


Figure 10: GDP in Perak by Industry, annual % change (2010-2016), adapted from DOSM (2017)

The change and relative percentage share differences within and between sectors are observable. It is noted that, even though growth is registered among the complete portfolio of economic activities, the sectors of Agriculture; Manufacturing; Utilities, Transportation and Storage; Wholesale and Retail Trade stand out in terms of share size. The specific growth trend for economic activities from 2010 to 2016 is observable in the Appendix (see Appendix 7). Specifically, while the majority of sectors exhibit a relatively stable trend, two exceptions are noted. One relates to the decrease of The Mining and Quarrying Industry, while the second one relates to the outstanding increase of the Construction Industry which, especially between 2011 and 2013, registers high growth in terms of GDP.

To present the reader with a visual overview of the structure of the Perak's State economy and the differences in relative sizes of GDP share per sector, two sunburst graphs are presented, relative to 2010 and 2016 (Figure 11).

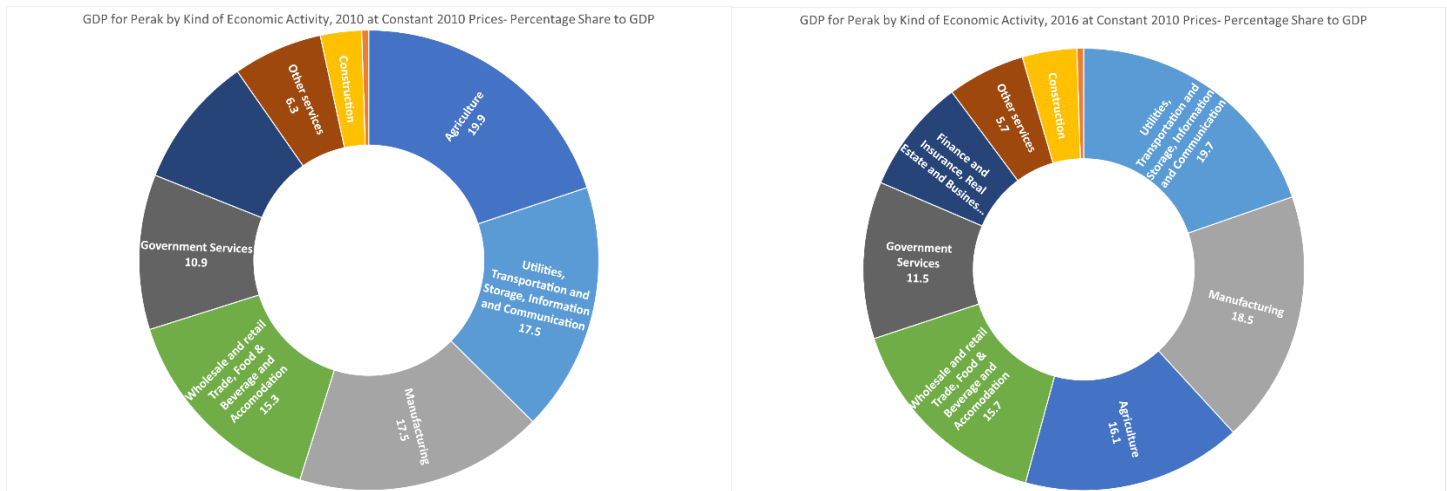


Figure 11: GDP in Perak by Industry, percentage share to GDP (2010, 2016), adapted from DOSM (2017)

Once again, the relative diversification of the economy at the State level is observable. The size of GDP share per sector is depicted in a hierarchical order, where the already-mentioned sectors represent the highest portion of the two graphs. It is interesting to note that, as anticipated, the economy of Perak exhibits a shift from an economic structure purely based on primary sectors to one increasingly centered around services. In fact, while in 2010 the highest percentage share is attributed to Agriculture, in 2016 this sector shifts into the second position, overtaken by the Utilities, Transportation and Storage sector.

From the analysis of GDP measures at the State level we derive three observations. Firstly, Perak's economy is diversifying over time. Secondly, the Agricultural and Mining sectors, once predominant in the region, are shrinking in favor to a more balanced economic structure built around the central role of service-related activities. Thirdly, it is observed that Perak, when compared to other States in Peninsular Malaysia, benefits from a restricted range of comparative advantages, making it one of the poorest States in terms of GDP per capita.

Labor force distribution

Moving on to the second indicator, labor force distribution per economic sector, the results obtained tend to emphasize the preliminary conclusions derived from the analysis of GDP share per economic activity at the State level. As anticipated in the Data section, bar graphs are produced to assess which States can be recognized as leaders in each kind of economic activity in 2017 (see Appendix 8 for complete representation). Here, a selection is made to present only those sectors in which Perak results as a leader, meaning that the State is found among the top five States in terms of number of persons employed per economic activity (Figure 12).

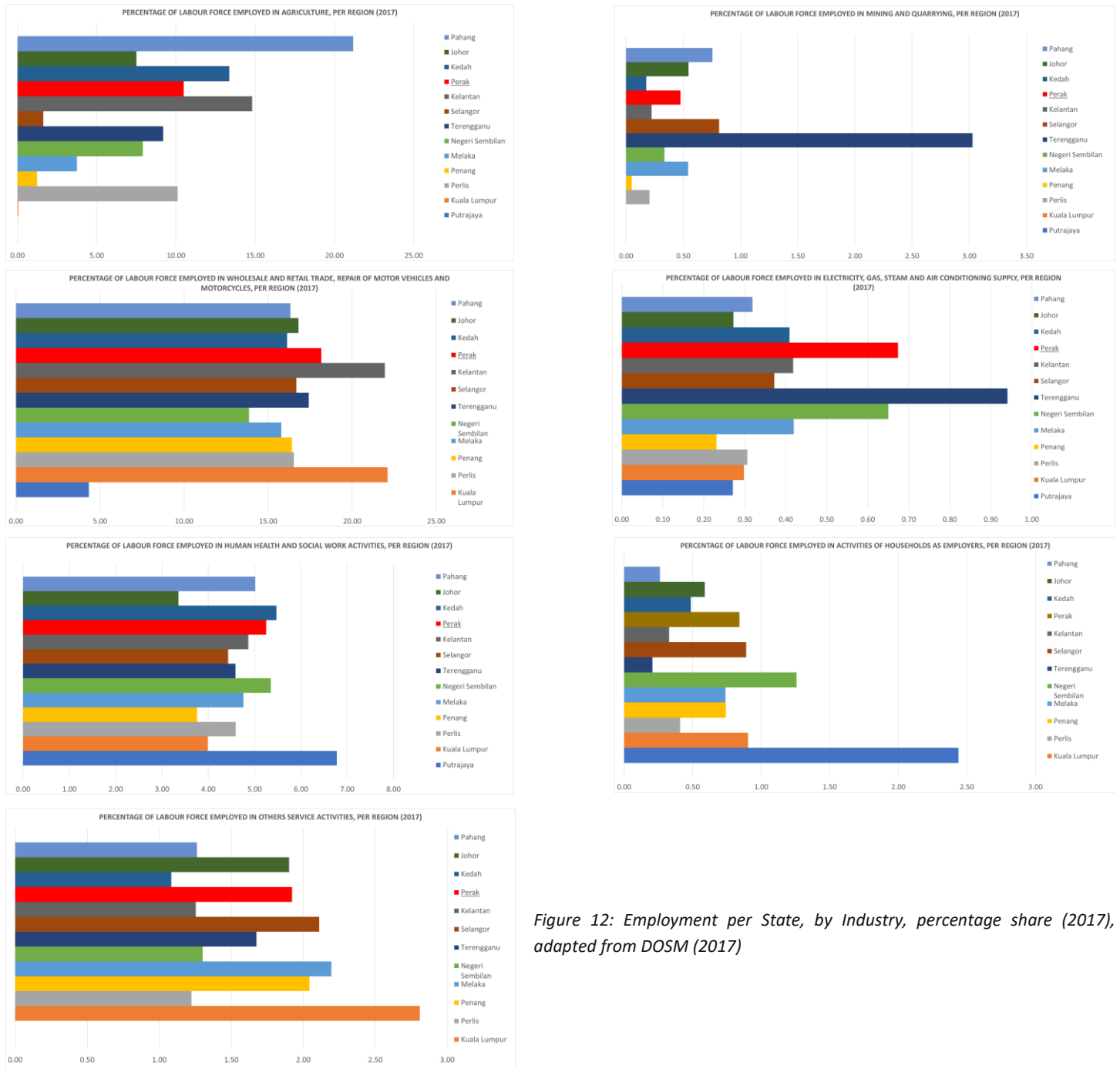


Figure 12: Employment per State, by Industry, percentage share (2017), adapted from DOSM (2017)

As visible from the graphs, in 2017 Perak results to be in the top five States in terms of labor force distribution in the sectors of Agriculture, Forestry and Fishing; Mining and Quarrying; Electricity, Gas, Steam and Air conditioning supply; Wholesale and Retail trade, Repair of motor vehicles and motorcycles; Accommodation and food service activities; Human health and Social work activities; Activities of households as employers; Other service activities. This employment structure gives a preliminary confirmation about the process of diversification taking place in the State of Perak. From these results, it appears that the labor force in the region is indeed distributed across a vast range of economic activities, of which the service sector represents a substantial share. Interestingly, the identification of competitive advantages in terms of labor force distribution reflects the findings relative to GDP share. In fact, when comparing the two observations, a variety of sectors are found in both dimensional rankings.

In order to offer the reader with a more comprehensive explanation, the internal division of the labor force per State across sectors is presented (see Appendix 9). Here, the percentage share per sector is visible, giving an indication of the degree of diversification and specialization of States in terms of employment distribution. Starting from these graphs, the diversified employment structure of Perak is benchmarked against the one of its neighboring State, Penang, which is used as an example of specialized economy (Figure 13).

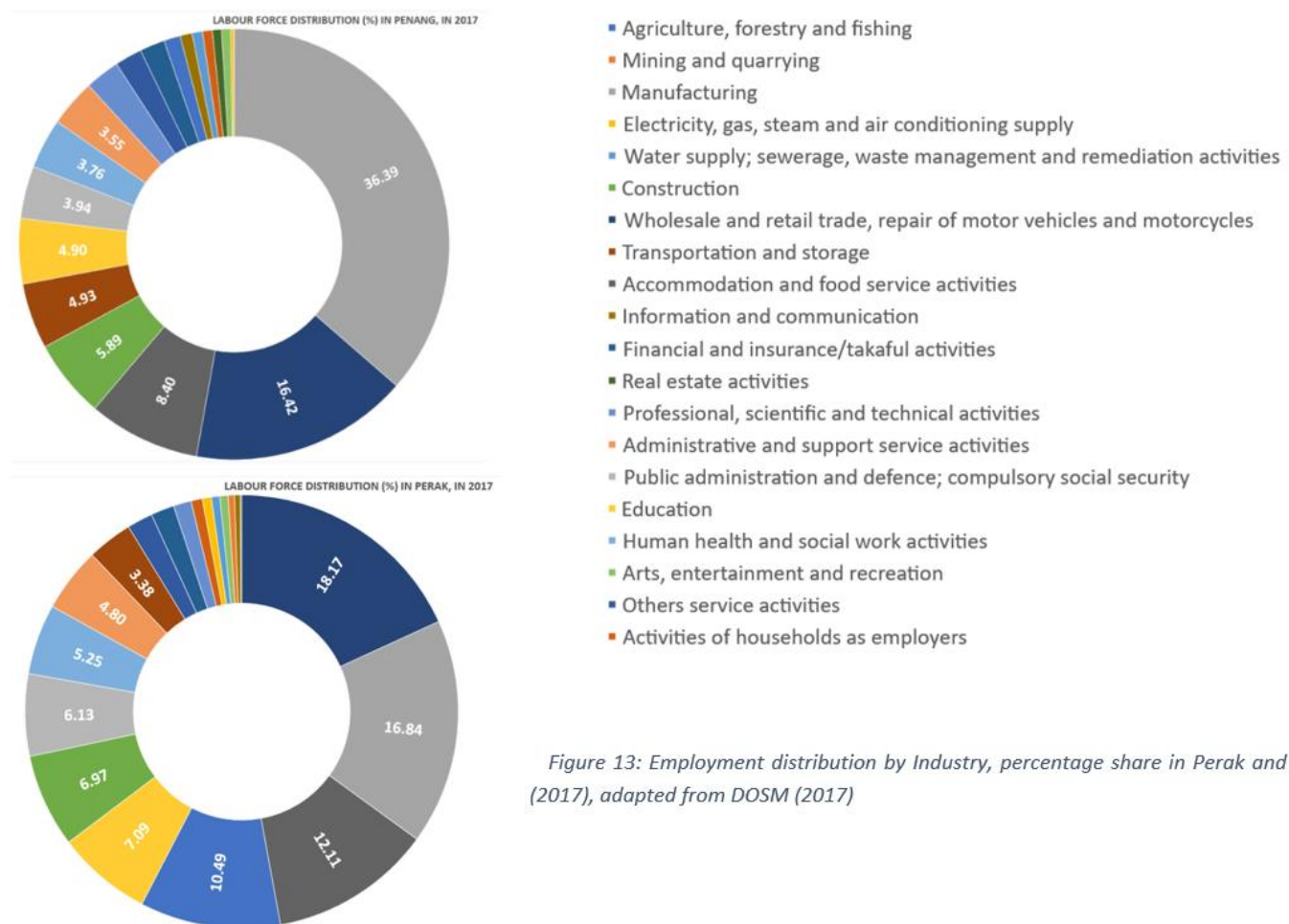
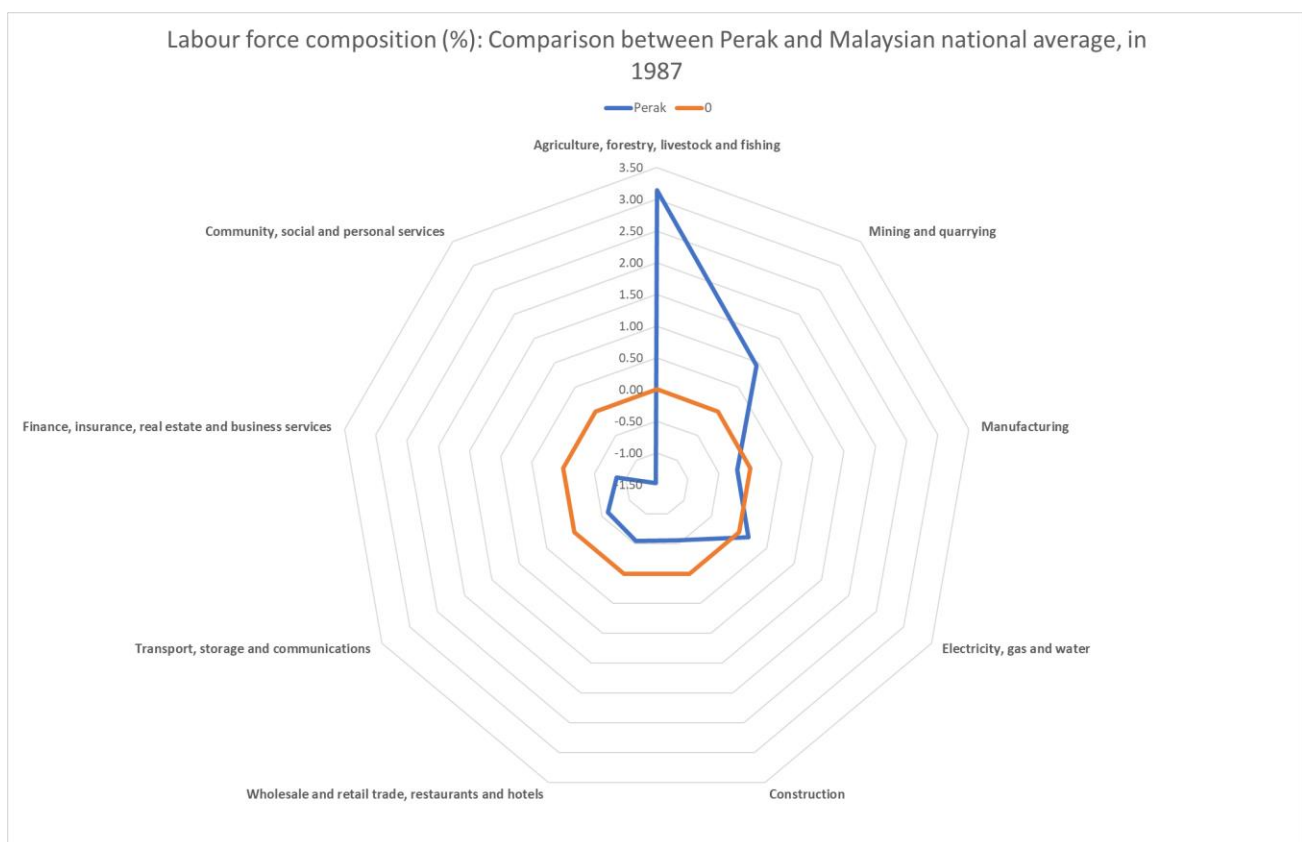
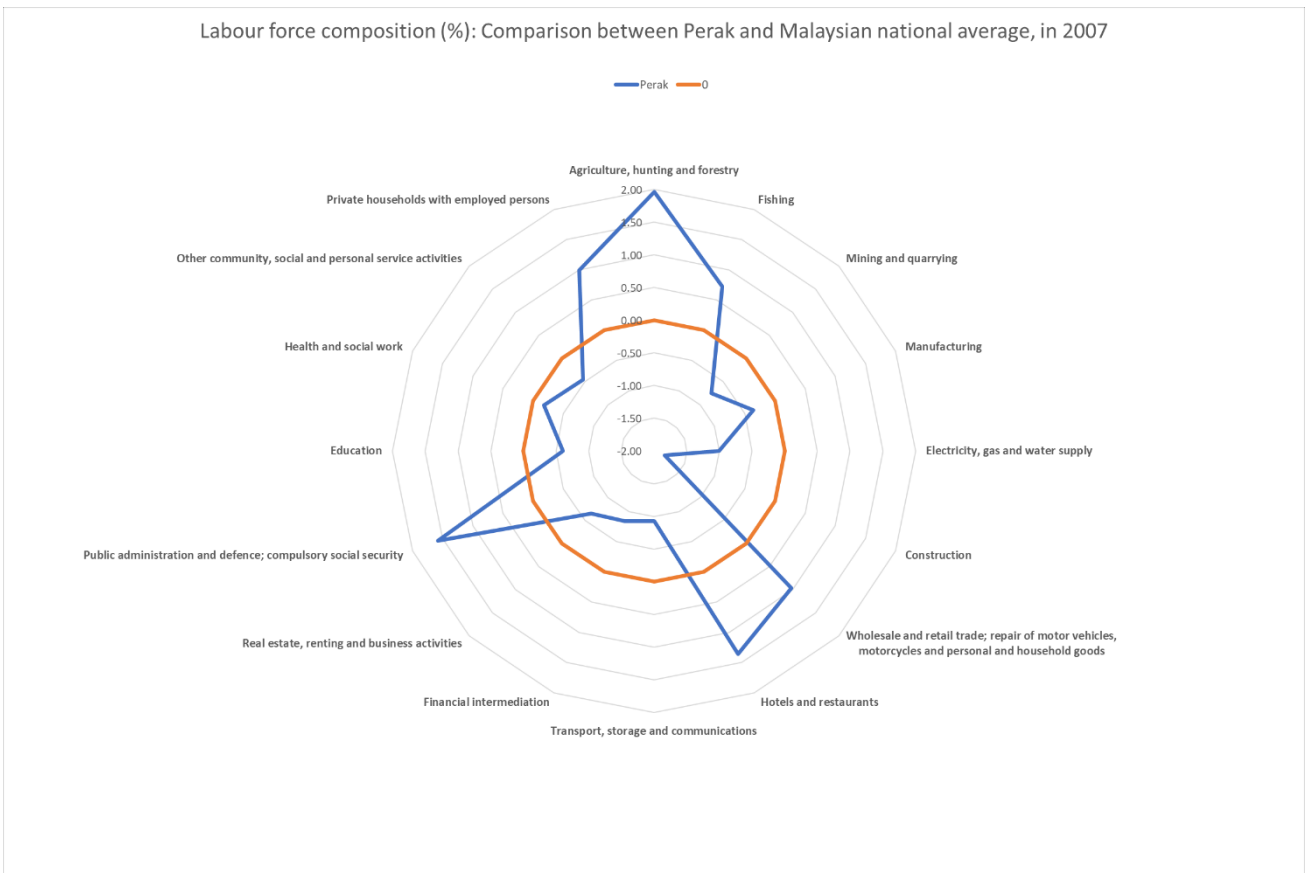
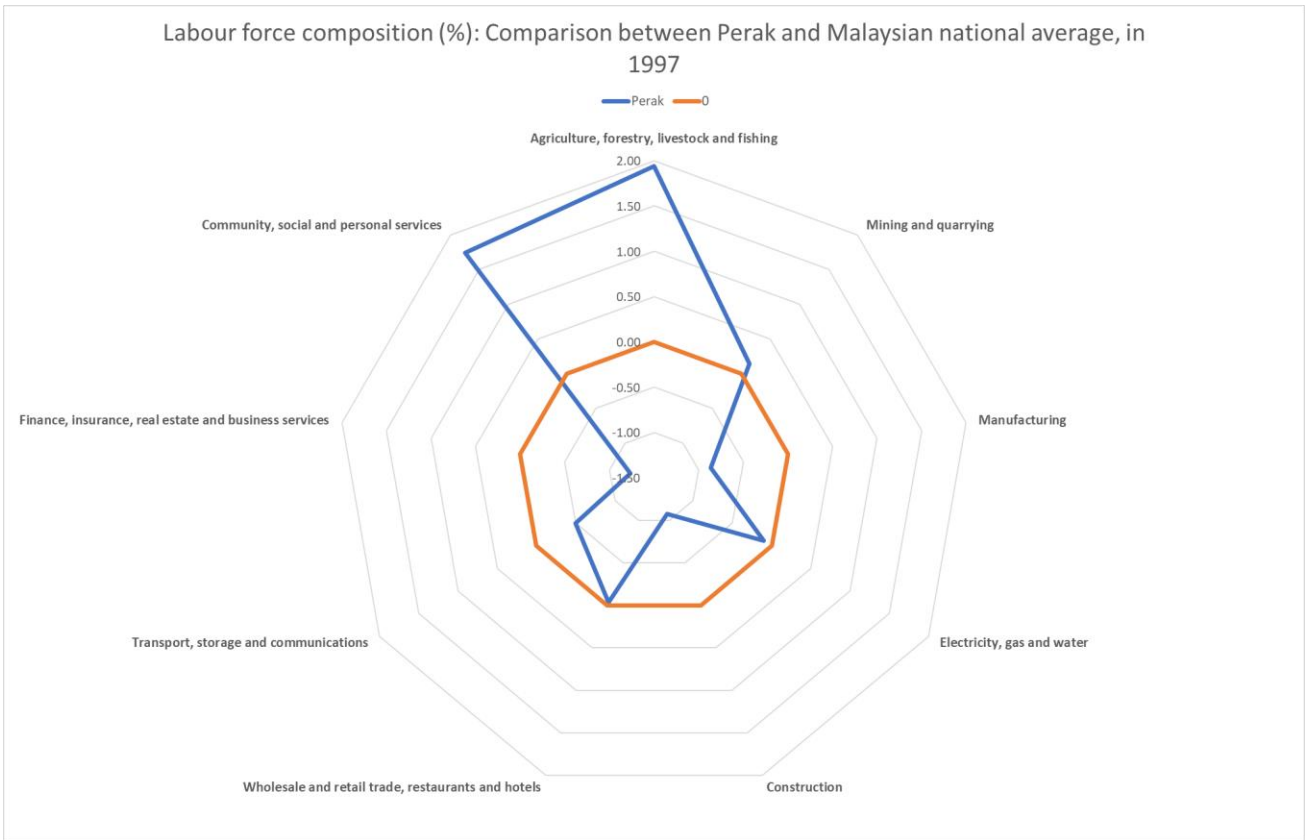


Figure 13: Employment distribution by Industry, percentage share in Perak and Penang (2017), adapted from DOSM (2017)

As visible in the two figures, the division of the labor force in Perak across its portfolio of sectors is more evenly distributed than the one observed in Penang. In fact, even though the components are the same in the two States, Penang's workforce results to be heavily concentrated in the Manufacturing sector. On the other hand, the workforce in Perak, even if highly concentrated in the Wholesale and Retail trade sector, presents relatively high percentages in the Manufacturing, Accommodation, Agriculture and Other sectors. As anticipated in the Theoretical body of the Research, this outcome is associated with a regional polycentric form, expected to be characterized by a relatively high degree of diversification.

Following the same line of reasoning applied for the GDP share indicator at the State level, radar graphs for the region of Perak are generated to offer a visual representation of its relative competitive advantages over time in terms of workforce distribution. In this case, as previously anticipated, the analysis is developed among a time period of over thirty years, giving us a much more complete picture of the spatial economic dynamics occurring in Perak (Figure 14).





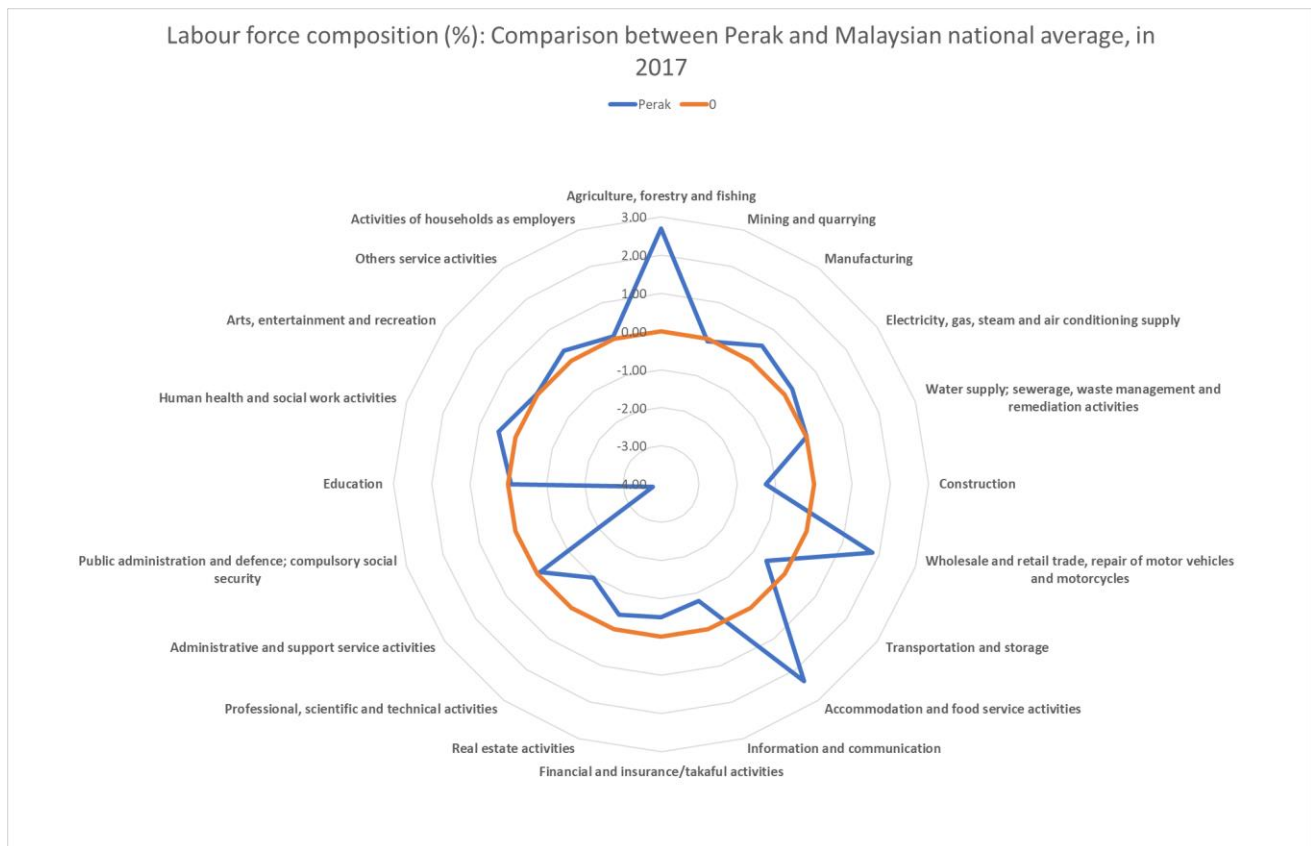


Figure 14: Labor force RCA by Industry in Perak (1987-2017), adapted from DOSM (2017)

From these graphs, relative to 1987, 1997, 2007 and 2017, it is observable how the region is in the process of diversifying its workforce. In fact, when the difference between the number of persons employed in Perak and the average of Peninsular Malaysia in a vast range of economic activities are compared over time, the change in the economic structure is striking. While in 1987 Perak's labor force presented a Relative Competitive Advantage only in a narrow range of economic activities, in 2017 the same region exhibits a relatively large array of economic activities in which a RCA is registered. This dynamic is already observable in 1997, when the labor force started to shift from an almost total concentration in the agricultural sector to a more service-oriented one. Looking at 2007, the change is even clearer and, moving to 2017, Perak reflects a highly diversified workforce in terms of persons employed per economic sector. As a matter of fact, recent data show a RCA in the sectors of Agriculture; Manufacturing; Electricity, gas, steam and air conditioning supply; Wholesale and Retail trade; Accommodation and food service activities; Human health and social work activities; Other service activities. On a general note, the structure of the graphs shifts from a relatively pointy one to a more circular one, visually indicating the increase in the range of economic activities at the State level in terms of employment.

After producing the graphs, the values are translated into two maps that indicate the workforce distribution per industry across space in Peninsular Malaysia (Figure 15).

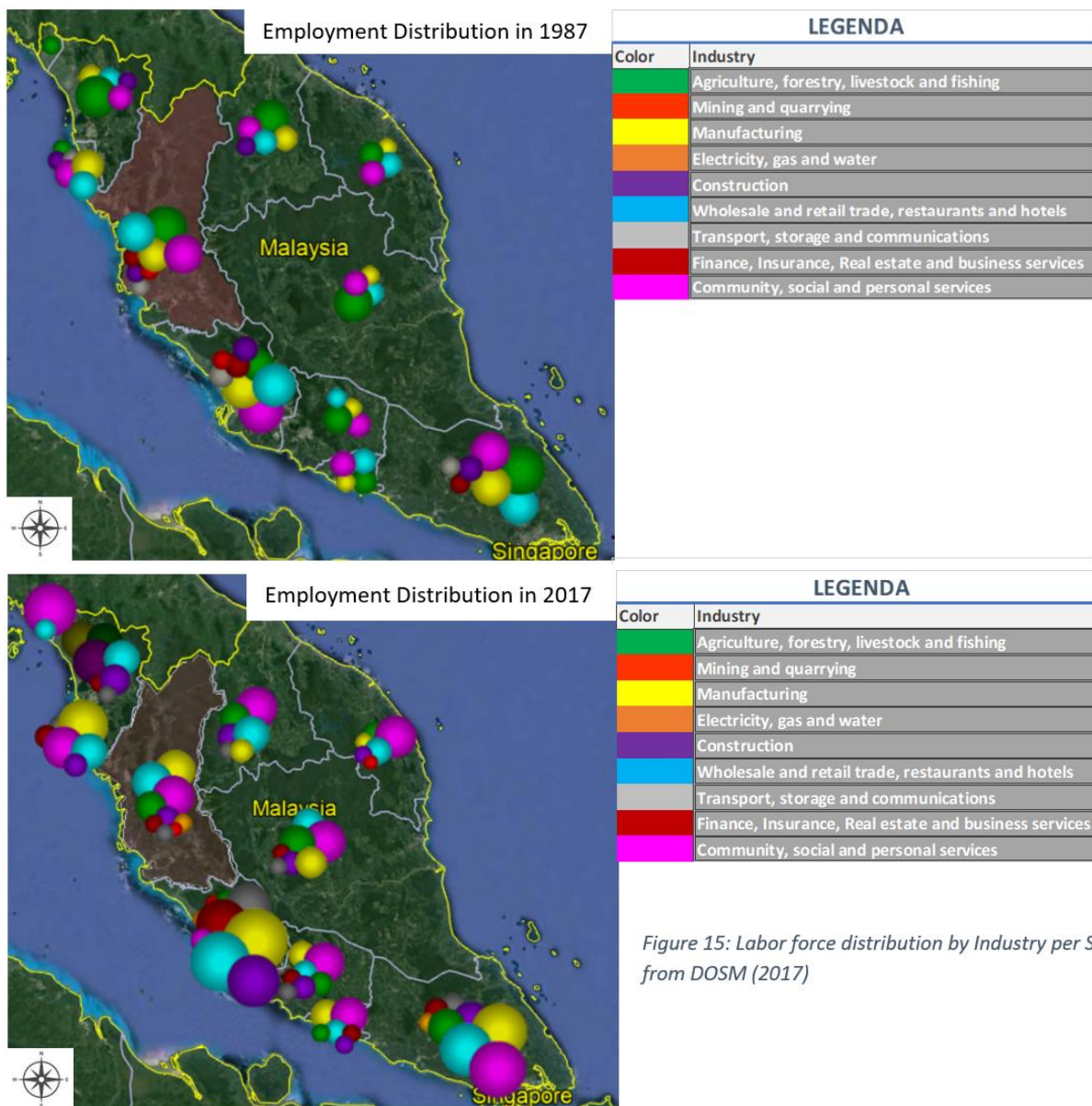




Figure 15: Labor force distribution by Industry per State (1987,2017), adapted from DOSM (2017)

In the figures above, the development of the portfolio of industries is shown. This visual representation is utilized to benchmark Perak to other States in Peninsular Malaysia, attempting to validate the observations made in regard to GDP share per capita. The first observation relates to the geographical distribution of economic sectors in Peninsular Malaysia, that shows a development oriented mainly towards the West coast of the Peninsula. Specifically, the States located in the Southern part of Peninsular Malaysia show a relatively greater growth, both in terms of economic sectors' size and variety of their portfolios. Particularly, the States of Selangor and Johor exhibit the highest absolute values in 2017 and the highest growth pace from 1987 to 2017 in relation to labor force. Also, a visible trend in the whole Peninsula suggests a shift towards a more service-oriented economy. In fact, while in 1987 the primary sectors, such as the agricultural one, were the major players in the economic sectoral composition of States, in 2017 the Administrative and Service-related sectors acquire a major role in the National economy. This, as anticipated, is reflected in the economy of the State of Perak too. As noticeable from the first figure, in 1987 Perak's employment was dominated by Agriculture. Furthermore, its portfolio

was relatively narrow in terms of economic activities. Over time, its portfolio widened, and new sectors appeared in the region, such as the Electrical, Health and Financial one. As a conclusive remark, relating back to our Research Question, the State of Perak shows a trend of diversification and growth over time in terms of workforce divisions, supporting the expectation that sees this State as a polycentric system at the Regional level.

As a next step, relatedness measures for the employment distribution at the National level are computed. The percentages of labor distribution across industries per State in Peninsular Malaysia are used to compute the relative competitive advantage of each one of the locational units under analysis. The RCA is analyzed across the four above-mentioned time periods (1987-2017), to obtain an analysis of the changes that occurred in Peninsular Malaysia in terms of employment over time. Interestingly, by leveraging the notion of path-dependence in the spatial (economic) structure of Regions, the latest results, relative to 2017, are used to produce a prediction of the development of the spatial (economic) system of Perak (Figure 16).

ECONOMIC SECTOR	EMPLOYMENT RCA	RELATEDNESS DENSITY (%)
Agriculture, forestry, livestock and fishing		
Mining and quarrying		30
Manufacturing		50
Electricity, gas and water		
Construction		25
Wholesale and retail trade, restaurants and hotels		
Transport, storage and communications		25
Finance, insurance, real estate and business services		20
Community, social and personal services		

EMPLOYMENT RCA:  Perak **has a RCA** in employment compared to other States in the selected sector in 2017.
 Perak **does not have a RCA** in employment compared to other States in the selected sector in 2017.


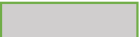
RELATEDNESS DENSITY:  The employment sector **is related** (>Average) to the portfolio of Perak in 2017.
 The employment sector **is not related** (<Average) to the portfolio of Perak in 2017.

Figure 16: Labor force Relatedness computations (2017)

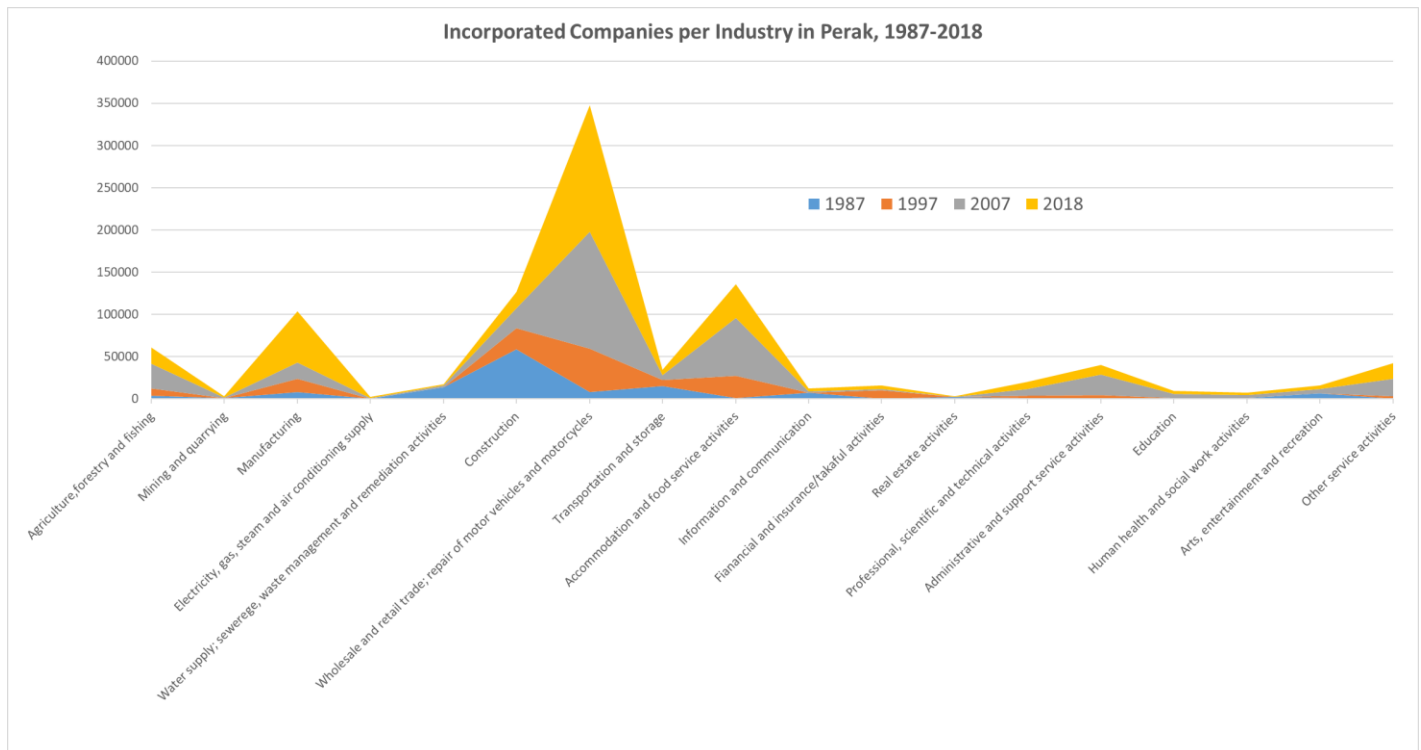
It is observable that Perak, in 2017, presents relative competitive advantages in the sectors of Agriculture, forestry, livestock and fishing; Electricity, gas and water; Wholesale and retail trade, restaurants and hotels; Community, social and personal services. Based on this information, among the sectors that are not part of the regional economic portfolio's advantages in 2017, the Manufacturing sector presents an above-average level of Relatedness Density. In other words, this sector is expected to become one additional source of competitive advantage for Perak in the year 2027 in terms of labor force distribution. Explicitly, this table indicates that the Manufacturing sector exhibits a high grade of cognitive

relatedness to the current workforce structure of Perak, which could be used as a solid basis for the introduction of such sector as a major source of employment.

To validate this finding, we compare the computed outcome to existing literature based on Perak 2020 and Perak 2040 regional plans, observing similarities in terms of economic activities that the region is planning to emphasize in the upcoming years. It is found that the regional Government of Perak is planning to develop a major manufacturing center in Tanjung Malim, located in the Batang Padang district. This development project is expected to generate substantial growth in terms of employment and population growth, estimated around 240.000 units in the next 5 years (Perak2020, 2017). By creating this new economic cluster, the manufacturing sector would benefit Perak on several dimensions. Not only it would widen the economic portfolio of the region, but it would do so by exploiting the current labor capabilities that it has developed in the last thirty years, as testified by measures of Related Variety. In this scenario, path-dependence becomes a crucial determinant for the economic restructuring of the region, confirming the sustainability of Government’s plans at the State level.

Incorporated companies

The last indicator used to complete the picture of the economy of Perak at the State level is the number of incorporated Companies in 1987, 1997, 2007 and 2018. These companies, divided per sector, are projected into two graphs that depict the composition of the economic portfolio of the region, highlighting the dominant sectors in the selected years (Figure 17).



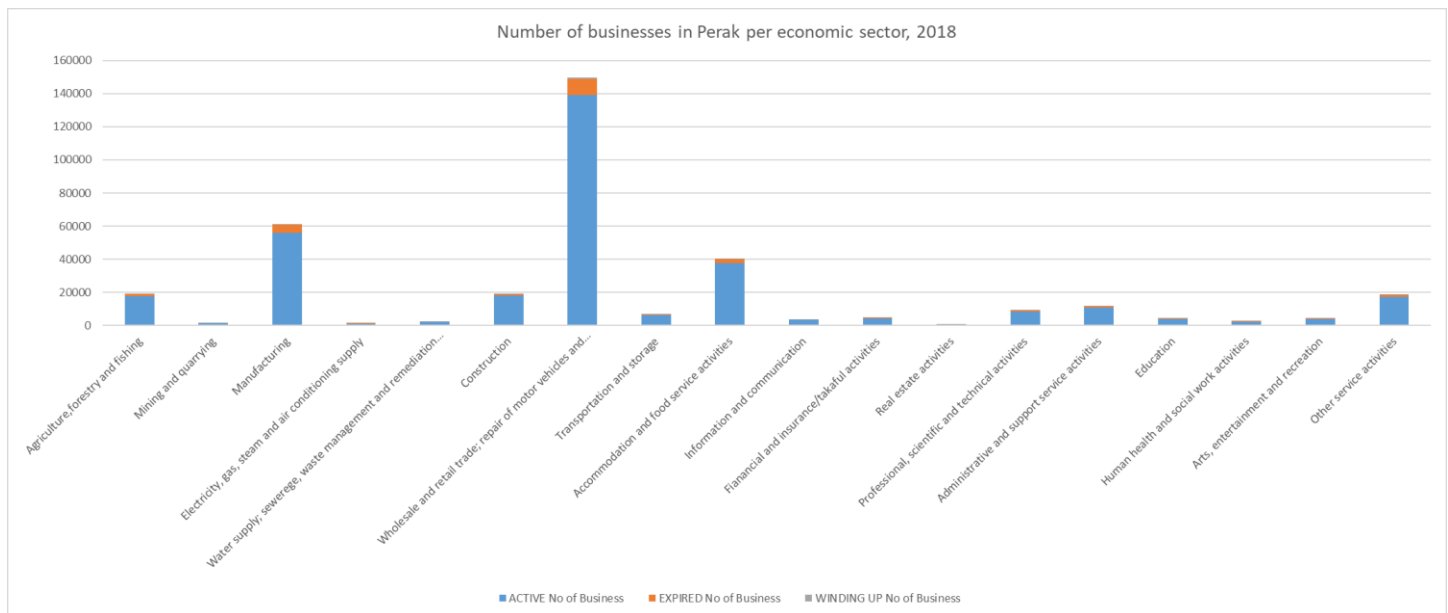


Figure 17: Incorporated Companies per Industry in Perak in 1987-2018 & Active, Expired and Winding up Companies in Perak in 2018, adapted from SSM (2019)

As observable, the Manufacturing, Wholesale, Accommodation, Administrative and Other services activities are predominant in the overall representation. Also, it is interesting to notice that the diversity in the economic portfolio of firms at the State level has not undergone significant changes. In fact, the composition of the portfolio remains quite unaltered over time, and the observable changes refer to the number of firms in specific sectors rather than the entry of previously non-existing sectors in the region. An additional remark refers to the proportion of Expired and Winding up businesses compared to the Active ones, which indicates an overall positive balance between entry and exit of incorporated Companies over the last thirty years.

These diagrams may be interpreted as a sign that Perak has maintained its diversity in the last thirty years, managing to leverage its already-mentioned strengths to increase the relative weight of relevant sectors in its economy. Even though this dataset does not indicate the overall number of Companies in the region but the number of Companies registered in that specific year, this indicator is used to show the fastest growing sectors in the region, and it is considered a very comprehensive proxy value for the composition of the Industry Space in Perak as a whole. As a matter of fact, when combining these latest results with the previous two indicators, findings match in terms of current and historical sectoral composition in the region.

To conclude, at the State level, Perak exhibits consistent measures of diversity in terms of GDP share, workforce distribution and incorporated Companies per economic sector. This diversity has been increasing over the years and confirms the polycentricity hypothesis at the Regional level. Secondly, through preliminary relatedness computations, it is found that the economy of Perak, at the State level, leverages its advantages moving towards new economic sectors that are cognitively related to the existing spatial economic structure of the region, proving the validity of our path-dependency hypothesis. As anticipated, the findings at the regional level will have to be matched with sub-regional ones to have a definite confirmation about the urban configuration of the region. In other words, once diversity is observed at

the regional level, one may expect sub-regional components to be characterized by a relatively specialized portfolio of industries and labor force, so to confirm functional polycentricity in the urban configuration of Perak.

5.1.2 District level

Number of Establishments

Firstly, the results relative to the analysis of the number of establishments per district are presented. The establishments are divided into five main categories, namely Agriculture, Manufacturing, Construction, Mining and Quarrying, and Services.

The first figure presents, in a hierarchical order, the districts in Perak to which the highest number of establishments belong to (Figure 18).

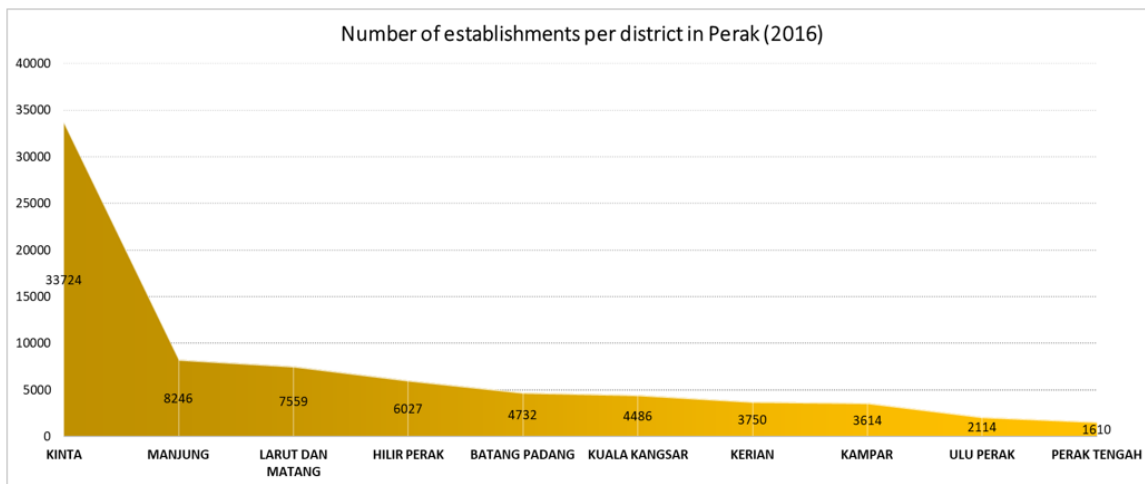


Figure 18: Establishments per district in Perak, 2016 (adapted from DOSM, 2016)

According to our polycentric expectation, the distribution of establishments across districts should reflect an even spatial distribution, without a clear dominant center. Nevertheless, it is noticed that, in absolute terms, Kinta has clearly a privileged role in terms of establishments located under its jurisdiction. However, to give the reader a more accurate representation of the spatial (economic) distribution of activities in Perak, the same graph is adjusted considering the population size of each district. The result is an area graph on which the total number of establishments per capita in every district is projected (Figure 19).

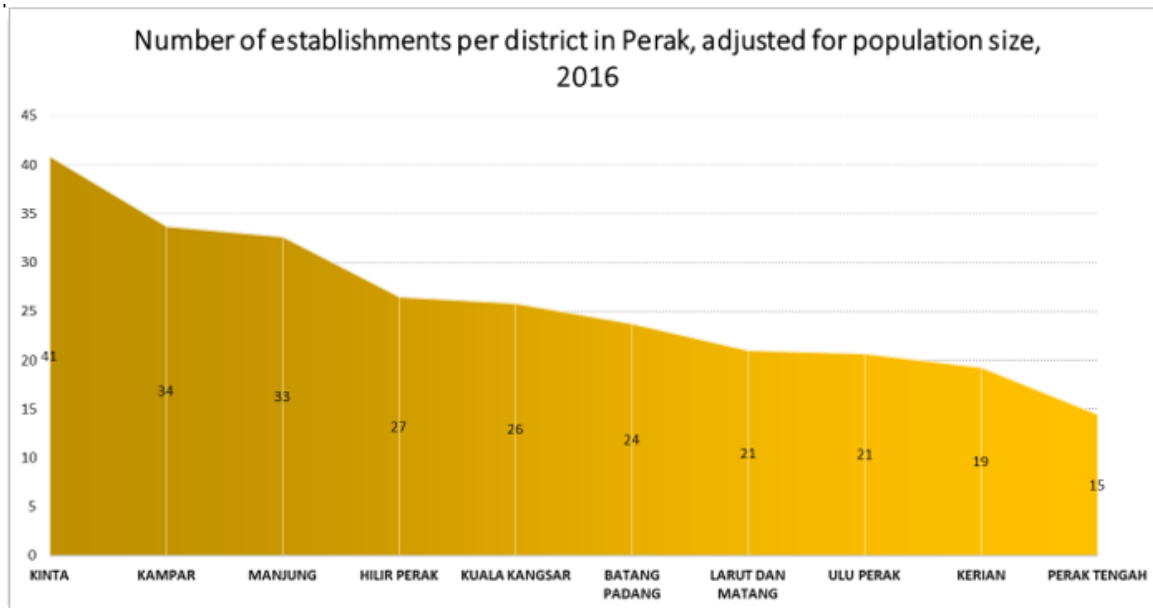


Figure 19: Establishments per district in Perak, adjusted for population size, 2016 (adapted from DOSM, 2016)

With this second graph, we are able to adjust our preliminary observation based on population size. In other words, even though Kinta appears to have a dominant role in absolute terms, its dominance is balanced out when the considerable differences in population size between districts are taken into account. From this analysis, it can be deduced that the geographical distribution of economic sectors in Perak is more evenly spread than its population. Explicitly, even though the population of Perak is heavily concentrated in Kinta, the number of establishments in Perak are well distributed among its inhabitants and cover the totality of the State. This, intuitively, underlines the importance of the link between the morphological and functional side of the study, referring back to the relevance of the intertwined discourse about the nodality and centrality of sub-regional units in Network Thinking. While Kinta stands out in terms of nodality, its centrality is not prevalent.

Next, the sectoral composition of establishments per district is shown. Following the same line of reasoning utilised at the State level, this allows us to observe the relative competitive advantage of every district in Perak, in terms of number of establishments, providing a more precise indication of the spatial (economic) evolution of Perak and the geographical distribution of employment in the region (see Appendix 10 for absolute values). Once again, attempting to control for the different population size across districts, the number of establishments per district is transformed into per capita values (Figure 20).

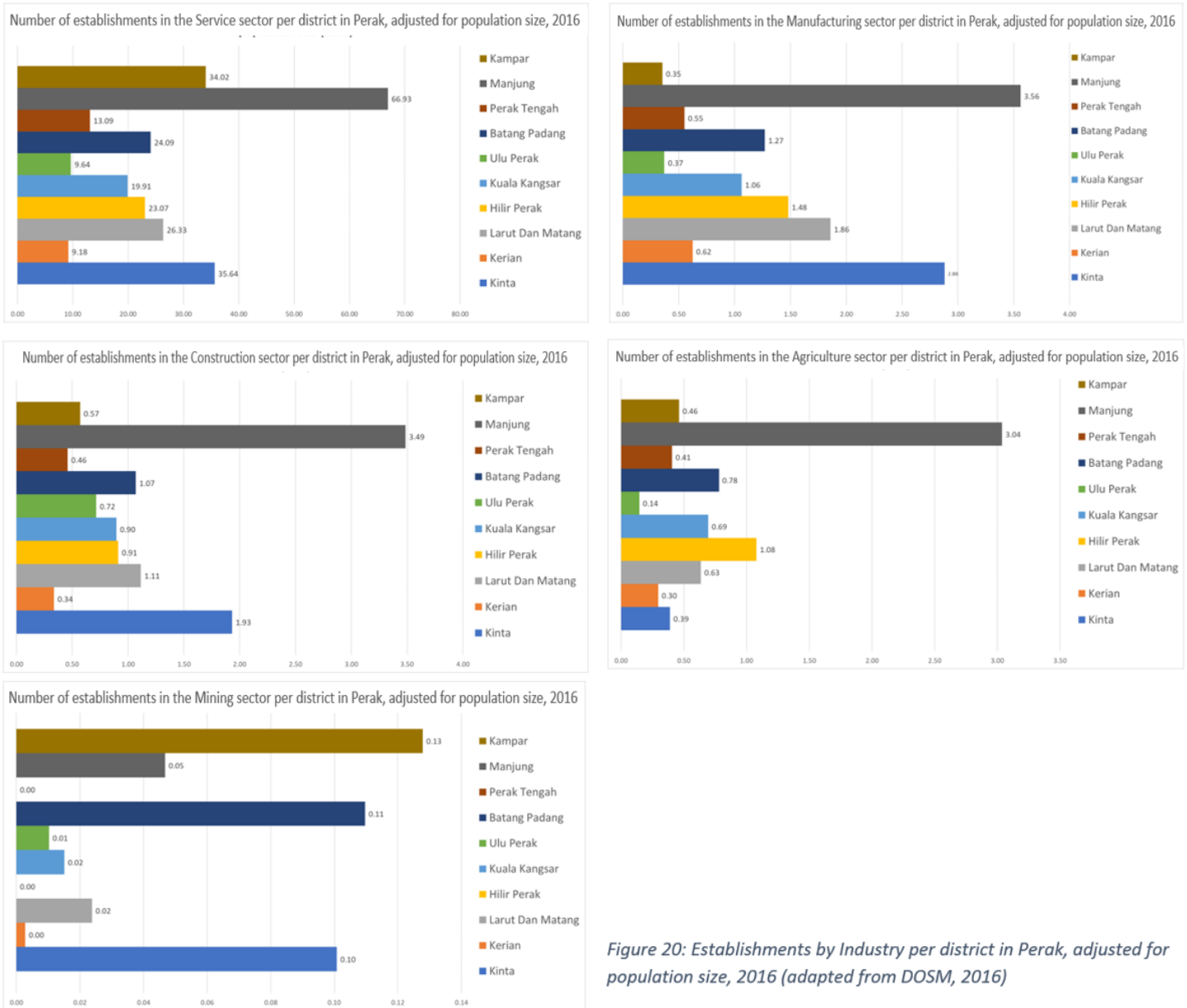


Figure 20: Establishments by Industry per district in Perak, adjusted for population size, 2016 (adapted from DOSM, 2016)

The results are rather surprising. In fact, opposite to our preliminary observations, Kinta loses its leader position in favor of Manjung when population size is taken into account. This indicates an imbalance between the morphological and functional side of the region. In other words, even though the Manjung district is characterized by a relatively small population, the number of establishments in the district is disproportionately high, making Manjung a major center for the economy of Perak. On the other hand, even though Kinta is characterized by the largest population in the region, the number of establishments located in this district is disproportionately low. Nevertheless, it has to be specified that the number of establishments does not provide us with the actual size of establishments in terms of production and employment. Therefore, it may be possible that Manjung is characterized by a great quantity of relatively small firms, while Kinta hosts a relatively low number of establishments that may be larger in terms of size, production and employment. Taking this into account, it could be hypothesized that the region of Perak is featured by two main centers,

Manjung and Kinta, which differ in terms of the role played in the regional economy. While Kinta is arguably the main urban center of the region, where the majority of the population concentrates, Manjung upsurges as a key industrial hub. Referring back to the Theoretical body of the Research, Kinta appears to be a major center in terms of nodality, while Manjung exhibits relatively greater centrality figures.

A second limitation regards the division of sectors. In fact, in the data provided by DOSM, the service sector aggregates several sub-sectors and does not allow us to have a precise analysis of its subdivision. Yet, we overcome this limitation utilizing a second indicator at the district level: the number of incorporated Companies. This indicator is also characterized by multiple time series, allowing us to assess not only the current sectoral composition of districts in Perak, but also their growth over a thirty years period.

Incorporated Companies

In regard to the second indicator at the district level, the number of incorporated Companies per sector, area graphs dedicated to specific industries are produced in order to show the growth of each district in number or incorporated firms from 1987 to 2018 (see Appendix 11). From these graphs, the central role of Kinta in the State economy is observable. As a matter of fact, this district registers the highest number of incorporated firms in absolute values, as well as the relatively highest and fastest growth over time. Apart from this observation, the secondary role of several districts is noted. This support role is attributed to different districts, based on the sector under analysis. On a general note, the districts of Manjung and Larut-Matang-Selama have a rather prominent role, especially considering those sectors in which Perak is characterized by a relative competitive advantage at the State level, such as Wholesale, Construction and Agriculture. It can be concluded that the statistics about the number of incorporated firms unravel a hierarchical structure of the regional economy, where Kinta is positioned at the top level. Nevertheless, the analysis cannot be limited to this preliminary and rather incomplete observation. In fact, as specified in the Model Conceptualization of the Research, polycentric configurations at the sub-regional level are determined by the specialization of their economic portfolios rather than their size. The disproportion in the number of Companies registered in Kinta may indeed be the result of the so-called nodality of this center, whose morphological characteristics and role as State's capital result in a relatively higher concentration of industries.

To offer a more in-depth analysis, a study of each district's economic development over time cannot be undervalued. The data collected on the number of firms incorporated from 1987 to 2018 allow us to do so. These computations are utilised to produce one of the most interesting illustrations of the Research: four radar graphs, relative to 1987, 1997, 2007 and 2018, for every district in Perak, where the number of incorporated Companies in that specific year is projected on the average of incorporated Companies in Perak. These graphs, similarly to the ones realised at the National and Regional level, depict the relative competitive advantage of each district in Perak over a thirty years period (Figure 21).





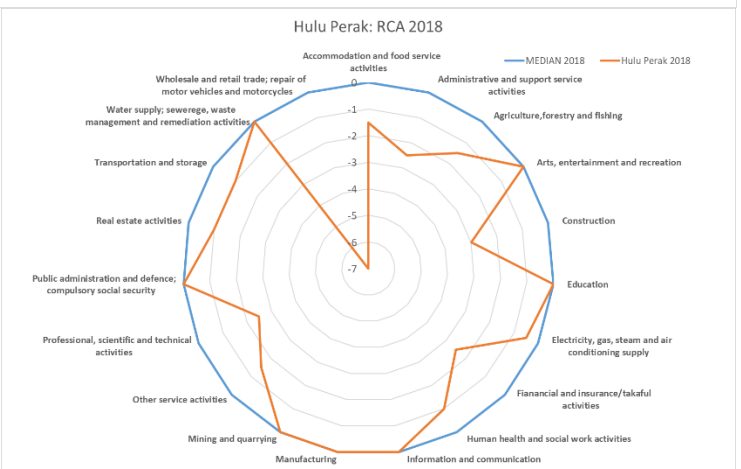
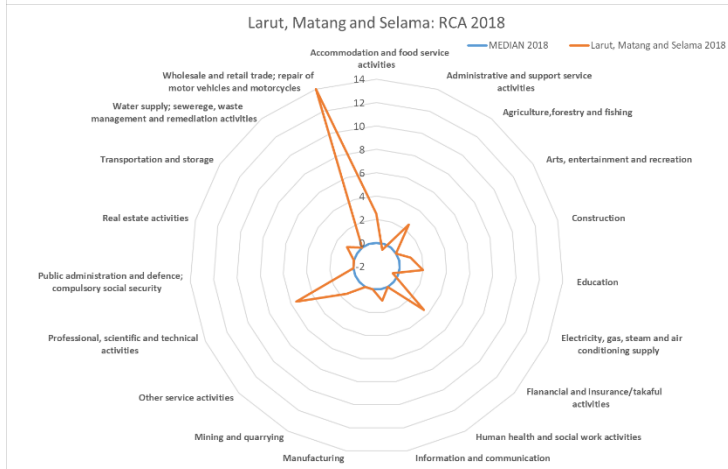
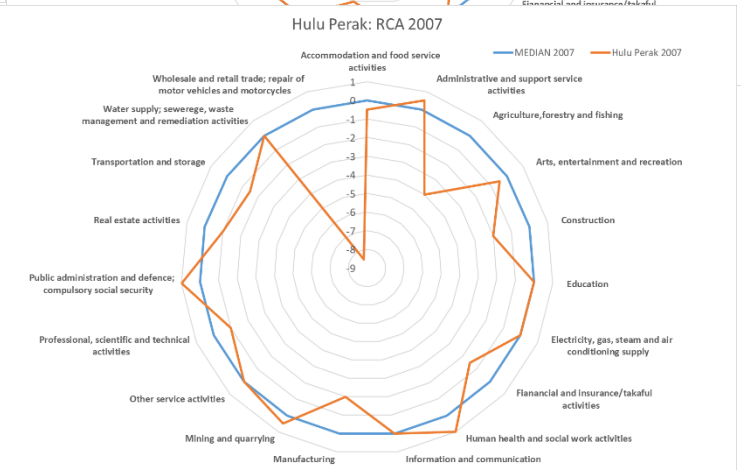
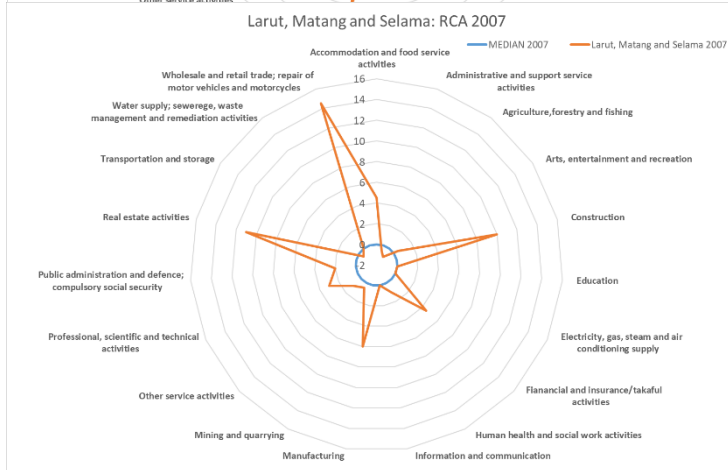
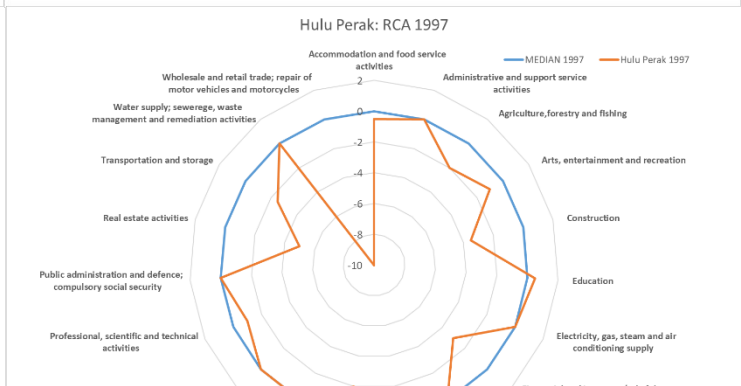
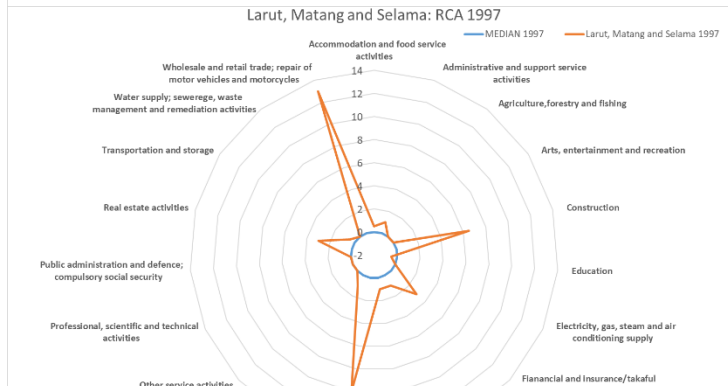
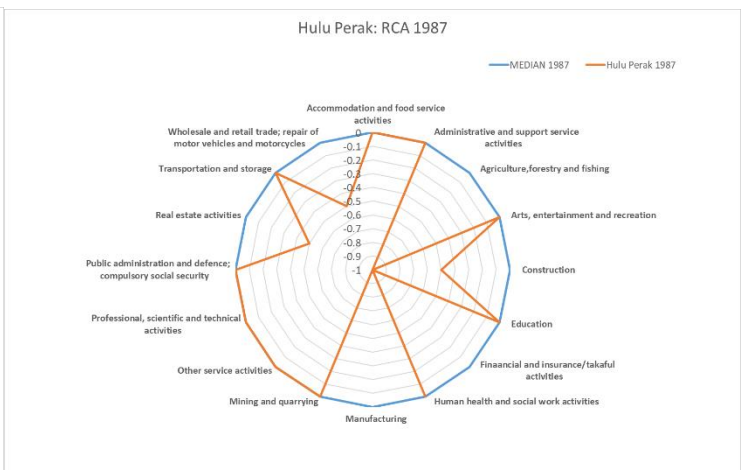
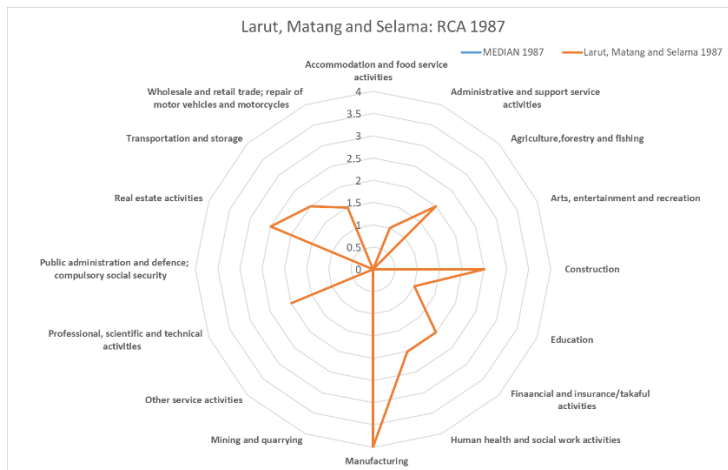




Figure 21: Relative Competitive Advantage per district for Incorporated Companies, 1987-2018 (SSM, 2019)

The structures depicted give a pilot indication about the role of path-dependence and the change in the spatial (economic) structure of sub-regional locational units in Perak, allowing us to enter the discourse on the link that exists between industries' relatedness and urban configuration in the region. The first observation regards the trend of diversification which was already identified at the regional level. In fact, when looking at the radar graphs produced for 1987, a clear pattern is observable, where the majority of districts is characterized by values lower than the regional average. This implies that the relative competitive advantage in the range of selected sectors is concentrated in a few districts that present remarkable advantages compared to the rest of the region. For instance, Kampar, Kuala Kangsar and Hilir Perak exhibit consistent benefits in the primary sector, while Kinta and Larut-Matang-Selama profit from advantages in a larger pool of sectors, positioning themselves as undisputed leaders in the regional economy in 1987. Moving on to the radar graphs for 1997 and 2007, the start of the diversification process is observed. Not only the relative competitive advantages are distributed across a higher number of districts, but specific districts exhibit a spikier structure, indicating the shift from a mainly specialized economy to a more diversified one. In 1997, even though Kinta preserves its front-runner role, the rest of districts seems to find their own niche sector, offering a good geographical balance on a sectors' complementarity level. Nevertheless, in 2007, this trend appears to be inverted. In fact, instead of focusing on the advantages gained in 1997, districts diversify into different activities, counterbalancing the complementarities that they managed to obtain in the previous decade. In other words, the structure of districts converges to a more circular one, indicating growing similarities across districts and less specific assets belonging to distinct locational units. As a matter of fact, in 2018, only a few districts maintain a specialized structure. For instance, Hilir Perak and Kuala Kangsar specialize in manufacturing, while Larut-Matang-Selama and Manjung specialize in Wholesale and retail trade. The rest is characterized by a diversified structure in terms of economic activities.

Linking this outcome to the urban structure scenarios, the relatively diversified structure of districts does not indicate a polycentric structure of the region of Perak. In fact, even though in 1987 high potentials for polycentrism are detected, this scenario fades over time. In 1987, complementarities between sectors were reflected into geographical complementarities, meaning that Perak was characterized by a fragmented distribution of industries, allowing each district to play a role in the economy. Nevertheless, in 1987, the economic system of the region was dominated by Kinta. On the other hand, in 1997, secondary districts gained importance while leveraging local assets, offering a positive prospective for polycentric development. Yet, in 2007 and 2018, it is safe to conclude that this prospective disappeared, as districts preferred to invest into economic activities that aligned their structure, underrating tailored local capabilities.

While the process of district diversification appears to be clear, an analysis of path dependence processes is necessary. In fact, it is crucial to gain an understanding about the decisional process behind the described outcome. Following this line of reasoning, relatedness measures at the district level are computed. The Relatedness Density for every sector in each of the districts of Perak is computed, giving a precise overview of the spatial (economic) distribution of incorporated companies per year in every locational unit, as well as sectors' relations with the current portfolio of industries in each district. Next, the relative competitive advantage of every district is computed. Combining these two measures, we are able to assess the grade of path-dependence observable between time periods (Figure 22).

1987: INCORPORATED COMPANIES PER INDUSTRY																
District	A	B	C	D	E	F	G	H	I	J	K	L	M	N	O	P
Batang Padang	0	0	2	0	0	0	0	0	0	0	0	0	0	0	0	1
Hilir Perak	0	0	3	0	3	0	1	0	2	1	0	1	0	2	0	4
Hulu Perak	0	0	2	0	0	0	0	0	0	0	0	0	0	0	0	4
Kampar	0	0	4	0	0	0	0	0	2	1	0	0	0	1	1	5
Kerian	0	0	2	0	0	0	1	0	1	0	0	0	0	0	0	3
Kinta	4	5	13	5	25	0	19	2	21	3	2	5	2	30	5	52
Kuala Kangsar	1	0	3	0	2	0	2	0	1	0	0	0	0	0	1	6
Larut-Matang-Selama	0	1	5	0	3	1	3	2	5	0	0	2	0	3	2	6
Manjung	0	0	4	0	1	0	2	0	0	0	0	0	0	1	0	5
Perak Tengah	0	1	0	0	0	0	0	0	0	0	0	0	0	0	0	1

LEGENDA 1987	
A	Accommodation and food service activities
B	Administrative and support service activities
C	Agriculture/forestry and fishing
D	Arts, entertainment and recreation
E	Construction
F	Education
G	Financial and insurance/takaful activities
H	Human health and social work activities
I	Manufacturing
J	Mining and quarrying
K	Other service activities
L	Professional, scientific and technical activities
M	Public administration and defence, compulsory social security
N	Real estate activities
O	Transportation and storage
P	Wholesale and retail trade, repair of motor vehicles and motorcycles

1987: RELATEDNESS DENSITY																	
District	A	B	C	D	E	F	G	H	I	J	K	L	M	N	O	P	AVERAGE RD 1987
Batang Padang	15.38	9.09	6.09	15.38	15.38	16.67	18.18	0	16.67	15.38	15.38	11.11	15.38	15.38	11.11	7.69	13.0
Hilir Perak	38.46	27.27	27.27	38.46	30.77	50	36.36	0	25	30.77	38.46	22.22	38.46	38.46	22.22	38.46	31.4
Hulu Perak	15.38	9.09	9.09	15.38	15.38	16.67	18.18	0	16.67	15.38	15.38	11.11	15.38	15.38	11.11	7.69	13.0
Kampar	38.46	27.27	27.27	38.46	38.46	50	36.36	0	25	30.77	38.46	22.22	38.46	38.46	22.22	30.77	31.4
Kerian	30.77	27.27	27.27	30.77	30.77	33.33	27.27	0	25	30.77	30.77	11.11	30.77	30.77	11.11	23.08	25.1
Kinta	61.54	72.73	72.73	61.54	61.54	33.33	72.73	0	66.67	69.23	61.54	66.67	61.54	61.54	66.67	69.23	60.0
Kuala Kangsar	30.77	36.36	36.36	30.77	30.77	46.07	27.27	0	33.33	38.46	38.46	33.33	38.46	38.46	33.33	30.77	31.3
Larut, Matang and Selama	30.77	18.18	18.18	30.77	30.77	83.33	18.18	100	16.67	30.77	30.77	11.11	30.77	30.77	11.11	30.77	32.7
Manjung	23.08	18.18	18.18	23.08	23.08	16.67	18.18	0	25	23.08	23.08	11.11	23.08	23.08	11.11	15.38	18.5
Perak Tengah	15.38	9.09	9.09	15.38	15.38	16.67	18.18	0	16.67	15.38	15.38	11.11	15.38	15.38	11.11	7.69	13.0

CELL STYLE	EXPLANATION
 	RD> AVERAGE 1987
 	RD< AVERAGE 1987
 	ENTRY IN 1997

1997: INCORPORATED COMPANIES PER INDUSTRY																			
District	A	B	C	D	E	F	G	H	I	J	K	L	M	N	O	P	Q	R	S
Batang Padang	1	2	5	1	2	1	0	1	0	0	0	2	0	0	0	7	2	0	12
Hilir Perak	1	0	7	2	5	1	0	4	0	1	3	0	1	0	0	6	3	0	13
Hulu Perak	0	1	1	0	1	1	0	0	0	0	0	0	0	0	0	0	0	0	2
Kampar	0	1	3	1	4	2	0	4	2	0	1	0	0	3	1	5	1	0	9
Kerian	0	0	3	0	5	0	0	2	0	0	2	0	0	1	0	2	3	0	3
Kinta	8	13	27	12	57	7	1	54	5	1	57	11	5	35	5	56	19	2	172
Kuala Kangsar	0	0	1	0	4	0	0	1	1	0	2	0	0	1	0	5	2	0	12
Larut-Matang-Selama	1	2	3	1	11	0	0	6	1	1	12	1	0	1	0	8	3	0	25
Manjung	4	2	4	1	5	0	0	5	0	0	5	0	0	5	0	4	9	0	21
Perak Tengah	0	0	0	0	2	0	0	0	0	0	1	0	0	0	0	0	0	0	1

1997 RELATEDNESS DENSITY																				
District	A	B	C	D	E	F	G	H	I	J	K	L	M	N	O	P	Q	R	S	AVERAGE RD 1997
Batang Padang	45.96	45.44	4538	4503	50.46	44.89	5025	50.47	50.28	51.81	50.33	45.03	5019	50.28	44.98	45.82	50.25	4438	48.0	
Hilir Perak	38.6	43.57	39.2	38.54	43.07	37.86	42.74	43.59	43.27	40.14	43.68	43.18	38.18	43.12	42.74	38.19	39.05	42.75	44.28	41.4
Hulu Perak	38.97	23.41	2331	2878	33.11	23.39	2871	28.1	29.15	2978	28.71	28.94	28.67	28.85	28.92	28.95	29.05	28.71	2232	27.4
Kampar	49.19	44.14	43.8	4406	49.5	44.94	4989	43.97	44.86	4927	49.32	49.81	49.53	44.24	44.85	43.99	49.27	49.89	5009	47.1
Kerian	23.17	22.33	1688	2222	16.87	22.13	2198	16.9	22.16	2378	22.31	22.07	22.08	22.33	21.97	22.34	17.12	21.98	2265	21.2
Kinta	55.57	56.12	5537	5041	56.05	56.41	5189	50.78	56.25	54.5	50.97	51.25	51.18	51.2	51.40	56.06	55.17	51.89	4994	53.3
Kuala Kangsar	29.36	29	28.98	28.69	23.42	28.89	28.62	28.98	23.59	3013	29.04	28.72	28.63	29.04	28.89	2337	23.44	28.42	2257	27.5
Larut-Matang-Selama	34.15	28.96	3448	3416	29.02	34.01	33.95	34.27	28.88	28.77	28.98	33.94	33.95	33.71	33.71	34.52	34.51	33.57	27.97	32.4
Manjung	24.24	23.38	28.69	28.37	28.59	28.08	28.32	28.59	28.11	28.39	28.61	28.41	28.05	23.22	28.17	28.51	24.06	28.32	2221	27.1
Perak Tengah	11.31	11.32	11.21	11.22	5.73	11.11	11.36	11.38	11.43	1218	5.73	11.34	11.25	11.35	11.28	11.34	11.39	11.36	11.58	10.8

LEGENDA 1997	
A	Accommodation and food service activities
B	Administrative and support service activities
C	Agriculture/forestry and fishing
D	Arts, entertainment and recreation
E	Construction
F	Education
G	Electricity, gas, steam and air conditioning supply
H	Financial and insurance/takaful activities
I	Human health and social work activities
J	Information and communication
K	Manufacturing
L	Mining and quarrying
M	Other service activities
N	Professional, scientific and technical activities
O	Public administration and defence, compulsory social security
P	Real estate activities
Q	Transportation and storage
R	Water supply, sewerage, waste management and remediation activities
S	Wholesale and retail trade, repair of motor vehicles and motorcycles

CELL STYLE	EXPLANATION
 	RD> AVERAGE 1997
 	RD< AVERAGE 1997
 	ENTRY IN 2007

2007: INCORPORATED COMPANIES PER INDUSTRY																			
District	A	B	C	D	E	F	G	H	I	J	K	L	M	N	O	P	Q	R	S
Batang Padang	1	1	1	0	2	0	0	1	0	0	1	1	0	1	0	0	1	0	9
Hilir Perak	3	2	8	1	2	0	0	3	0	0	2	0	1	0	0	8	2	0	12
Hulu Perak	0	1	0	0	0	0	0	0	1	0	0	1	1	0	1	0	0	0	1
Kampar	0	0	2	2	1	0	0	0	0	0	1	0	1	0	0	0	0	0	8
Kerian	0	0	6	0	3	0	1	0	1	0	2	0	1	0	0	0	2	0	8
Kinta	14	15	10	6	62	2	0	25	2	3	52	22	14	29	12	31	17	4	149
Kuala Kangsar	0	0	5	0	2	0	0	2	0	0	2	0	0	1	0	2	3	0	10
Larut-Matang-Selama	5	0	3	1	12	0	0	6	1	0	8	1	2	4	2	12	1	0	24
Manjung	2	10	17	1	8	0	1	9	0	1	7	2	5	5	0	5	5	0	39
Perak Tengah	0	0	1	0	0	1	0	0	0	0	1	0	0	1	0	0	0	0	1

2007 RELATEDNESS DENSITY																			
District	A	B	C	D	E	F	G	H	I	J	K	L	M	N	O	P	Q	R	S
Batang Padang	26.67	44.44	50	33.33	33.33	33.33	37.5	37.5	30.77	37.5	33.33	31.25	35.29	31.25	33.33	33.33	31.25	33.33	29.41
Hilir Perak	26.67	33.33	50	26.67	23.33	33.33	50	31.25	23.08	37.5	33.33	37.5	35.29	37.5	33.33	26.67	31.25	33.33	35.29
Hulu Perak	26.67	22.22	50	26.67	26.67	26.67	37.5	25	23.08	25	26.67	25	23.53	31.25	20	26.67	25	26.67	29.41
Kampar	20	33.33	0	13.33	20	20	37.5	18.75	23.08	18.75	20	18.75	11.76	18.75	20	20	16.75	20	11.76
Kerian	33.33	35.56	50	33.33	26.67	33.33	62.5	31.25	30.77	31.25	33.33	31.25	29.41	31.25	33.33	33.33	25	33.33	29.41
Kinta	53.33	33.33	0	53.33	46.67	46.67	12.5	50	53.85	48.75	46.67	48.75	47.06	48.75	46.67	53.33	50	46.67	47.06
Kuala Kangsar	26.67	44.44	0	26.67	26.67	26.67	50	18.75	15.38	25	26.67	25	23.53	21	26.67	20	18.75	26.67	17.65
Larut-Matang-Selama	4	11.11	0	46.67	4	46.67	25	31.25	38.46	37.5	40	48.75	41.18	48.75	40	40	37.5	46.67	41.18
Manjung	33.33	77.78	100	33.33	33.33	33.33	87.5	37.5	23.08	37.5	33.33	37.5	35.29	37.5	33.33	33.33	37.5	33.33	35.29
Perak Tengah	20	22.22	0	20	20	13.33	12.5	18.75	23.08	18.75	13.33	18.75	17.65	12.5	20	20	16.75	20	17.65

LEGENDA 2007	
A	Accommodation and food service activities
B	Administrative and support service activities
C	Agriculture, forestry and fishing
D	Arts, entertainment and recreation
E	Construction
F	Education
G	Electricity, gas, steam and air conditioning supply
H	Financial and insurance/takaful activities
I	Human health and social work activities
J	Information and communication
K	Manufacturing
L	Mining and quarrying
M	Other service activities
N	Professional, scientific and technical activities
O	Public administration and defence; compulsory social security
P	Real estate activities
Q	Transportation and storage
R	Water supply, sewerage, waste management and remediation activities
S	Wholesale and retail trade; repair of motor vehicles and motorcycles

CELL STYLE	EXPLANATION
Light Green	RD > AVERAGE 2007
Light Orange	RD < AVERAGE 2007
Light Yellow	ENTRY IN 2017

2018: INCORPORATED COMPANIES PER INDUSTRY																			
District	A	B	C	D	E	F	G	H	I	J	K	L	M	N	O	P	Q	R	S
Batang Padang	1	1	2	0	2	0	0	2	1	1	1	1	1	3	0	1	2	0	11
Hilir Perak	2	3	7	1	5	0	0	4	1	0	8	0	2	3	0	5	1	0	8
Hulu Perak	0	0	1	0	2	0	0	0	0	1	1	1	0	0	0	0	0	0	2
Kampar	3	4	3	2	5	1	1	3	0	1	1	2	2	2	0	0	0	0	5
Kerian	1	0	1	0	6	0	2	2	0	0	0	1	0	1	0	6	1	0	10
Kinta	46	33	35	4	56	12	1	32	10	13	48	9	16	35	5	32	19	3	151
Kuala Kangsar	0	2	2	0	4	0	1	1	0	0	5	1	1	1	1	1	0	1	8
Larut-Matang-Selama	4	2	5	0	6	2	0	6	1	2	1	1	3	8	0	1	2	0	23
Manjung	3	3	11	0	15	0	0	4	1	1	7	1	3	6	0	5	7	1	28
Perak Tengah	0	3	1	0	0	0	1	0	1	1	0	0	1	0	0	0	0	0	1

LEGENDA 2007	
A	Accommodation and food service activities
B	Administrative and support service activities
C	Agriculture, forestry and fishing
D	Arts, entertainment and recreation
E	Construction
F	Education
G	Electricity, gas, steam and air conditioning supply
H	Financial and insurance/takaful activities
I	Human health and social work activities
J	Information and communication
K	Manufacturing
L	Mining and quarrying
M	Other service activities
N	Professional, scientific and technical activities
O	Public administration and defence; compulsory social security
P	Real estate activities
Q	Transportation and storage
R	Water supply, sewerage, waste management and remediation activities
S	Wholesale and retail trade; repair of motor vehicles and motorcycles

Figure 22: Related Variety computations, 1987-2018

From the tables above, it is possible to estimate the percentage of newly incorporated Companies in a specific year that were characterized by an above-average level of Relatedness Density in the given district in the precedent time period. In other words, we can estimate if a new sector is related to the portfolio of industries in a specific locational unit in a given

point in time. Starting from the period 1987-1997, the entry of 42 new sectors across all districts is recorded. Of these industries, 65% of newly incorporated companies in 1997 belonged to a sector that was related to the portfolio of industries in the given district in 1987. In the second time period, from 1997 to 2007, the entry of 19 new sectors is recorded. Of these industries, 100% of newly incorporated companies in 2007 belonged to a sector that was related to the portfolio of industries in the given district in 1997. From 2007 to 2018, the entry of 39 new sectors is recorded across all districts. Of these industries, 67% of newly incorporated companies in 2018 belonged to a sector that was related to the portfolio of industries in the given district in 2007.

These three results confirm the relevance of path-dependent processes in the region of Perak, which managed to follow an economic development based on the tailored capabilities of its districts. Therefore, even if the diversification process is undeniable, this does not appear to be a random one, but instead dictated by a logic of bundling advantages to move into higher value-added activities. Nevertheless, this does not change the reality that districts in Perak lost an opportunity to move towards a highly efficient and specialized economy.

Also, following the same line of reasoning utilised at the National level, it is possible to estimate the future composition of industries' portfolios in each district by observing values of Relatedness Density in 2018. Based on the assumption that path-dependence estimations would have a level of accuracy in the range of 60-100%, computed in Figure 22, one is able to predict the portfolio of industries for each district in a ten years' time (Figure 23).

2018 RELATEDNESS DENSITY																			
District	A	B	C	D	E	F	G	H	I	J	K	L	M	N	O	P	Q	R	S
Batang Padang	47.06	44.44	44.44	43.75	44.44	47.06	36.36	38.89	41.18	41.18	47.06	38.89	38.89	41.18	44.44	44.44	43.75	47.06	38.89
Hilir Perak	47.06	38.89	38.89	43.75	44.44	47.06	54.55	38.89	41.18	47.06	41.18	44.44	38.89	47.06	44.44	38.89	43.75	41.18	44.44
Hulu Perak	29.41	27.78	22.22	31.25	22.22	29.41	27.27	27.78	29.41	23.53	23.53	22.22	27.78	29.41	27.78	27.78	31.25	29.41	27.78
Kampar	52.94	55.56	55.56	62.5	55.56	52.94	63.64	55.56	58.82	52.94	58.82	55.56	58.82	61.11	61.11	56.25	58.82	61.11	61.11
Kerian	29.41	33.33	33.33	37.5	27.78	29.41	45.45	27.78	29.41	29.41	29.41	27.78	33.33	29.41	33.33	27.78	31.25	35.29	27.78
Kinta	41.18	38.89	44.44	50	44.44	41.18	27.27	44.44	41.18	41.18	41.18	44.44	44.44	47.06	38.89	38.89	50	47.06	44.44
Kuala Kangsar	47.06	44.44	50	50	44.44	47.06	63.64	50	47.06	47.06	41.18	44.44	44.44	47.06	44.44	50	50	47.06	44.44
Larut-Matang-Selama	41.18	38.89	33.33	43.75	38.89	35.29	36.36	33.33	41.18	35.29	41.18	38.89	33.33	35.29	38.89	38.89	43.75	41.18	33.33
Manjung	29.41	27.78	22.22	18.75	22.22	29.41	36.36	27.78	29.41	29.41	29.41	27.78	27.78	29.41	27.78	27.78	25	23.53	22.22
Perak Tengah	29.41	27.78	27.78	37.5	33.33	29.41	27.27	33.33	23.53	23.53	29.41	33.33	27.78	29.41	33.33	33.33	31.25	35.29	33.33

CELL STYLE	EXPLANATION
	RD>AVERAGE 2018
	RD<AVERAGE 2018
	POSSIBLE NEW ENTRY IN 2028

Figure 23: Related Variety computations, 2018

The estimations depicted in the table indicate an above-average probability of entry for a large variety of industries in those districts, such as Perak Tengah and Hilir Perak, that are behind others in terms of variety in their portfolio of industries. In a rather simplistic way, the prediction indicates that the process of diversification at the regional level is expected to continue, and the structure of the economy will result in a more fragmented one, with districts acting as islands in an archipelago system. For sake of explanation, according to the prediction, in 2028, each district will dispose of a portfolio of industries that should allow them to operate independently of neighboring districts, positively affecting their self-sufficiency.

Combining the measures retrieved from the number of incorporated Companies for specific districts, two indexes per time period are computed, namely Diversity index and Ubiquity index. These indexes are computed for 1987, 1997, 2007 and 2018, providing us with a clear view on the diversification dynamics characterizing districts in Perak in the last thirty years (Figure 24).

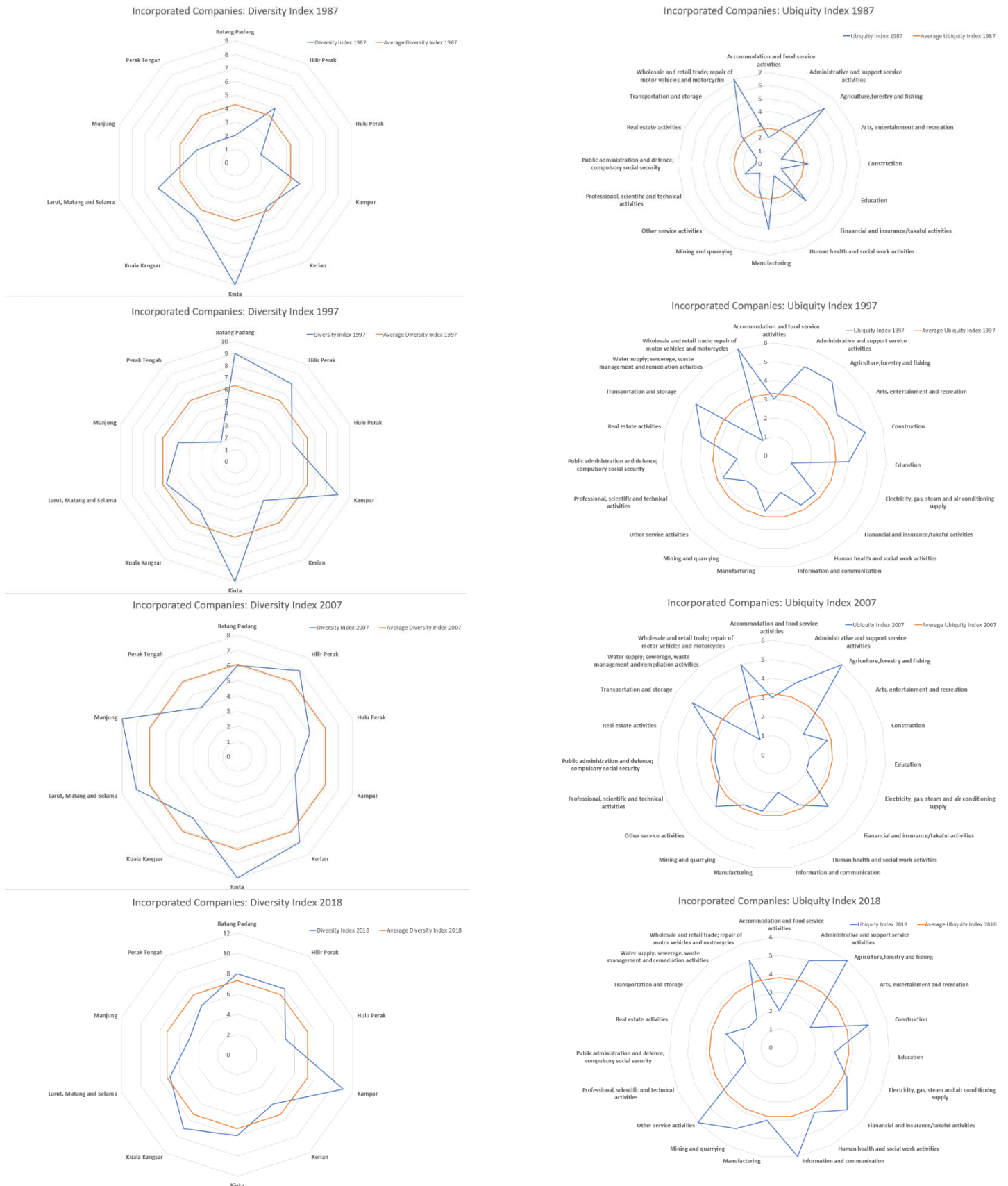


Figure 24: Diversity and Ubiquity Index based on Incorporated Companies, 1987-2018

From the graphs, our preliminary findings are confirmed. In fact, analyzing the Diversity Index over time, one is able to observe how the average diversity across districts increases. Explicitly, when comparing 2018 to 1987, it is clear that a higher number of districts is characterized by a relatively diverse portfolio of industries. Furthermore, when analyzing the Ubiquity Index, sectors become more frequent over time, appearing in a much larger set of districts in 2018 compared to 1987. Similarly to the Diversity Index, the average value for the Ubiquity Index increases over time, indicating that a growing number of sectors can be found in more locational units, eliminating the effects of specialized local assets. Once again, the pattern of diversification of locational units is striking. What once used to be a fragmented and highly specialized economy, is now transforming into a diversified one, where districts act as separate entities. This, intuitively, negatively affects complementarities among geographical locations within Perak, introducing issues of duplication and lack of expertise.

Economic Corridors

The last step for the analysis of the sub-regional dimension in Perak is constructed around the evaluation of economic corridors. The analysis takes the computed RCA and Relatedness Density values at the district level for the year 2018, looking at possible complementarities of industries (Figure 25). The computed RCA is based on the number of incorporated Companies per district.

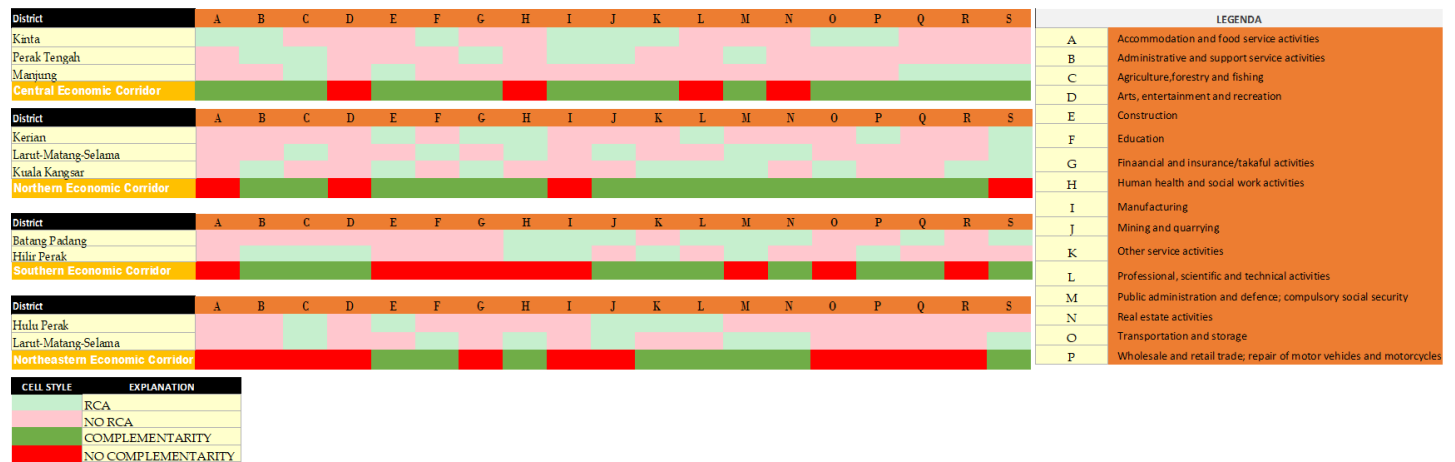


Figure 25: Economic corridors complementarity in 2018

As visible from the tables, the effectivity of Economic Corridors is in doubt. In fact, the bundling of districts does not seem to bring any consistent advantages to the economy of Perak in terms of economic sectors' complementarities. Nevertheless, the Northern and Central corridors indicate a potential for development for the districts selected. In fact, the Northern Corridor is constituted by Kerian, one of the few relatively specialized districts in Perak, Larut-Matang-Selama, focused on the primary sector, and Kuala Kangsar, centered on service activities. By grouping together these three structurally different Districts, the economy may indeed prosper. In terms of network connectivity, specifically, Kuala Kangsar and Larut exhibit complementarities that, if leveraged, may constitute a prolific interconnectedness among

economic sectors. Also, Kerian, which is lacking behind in terms of number of incorporated Companies in its territory, may take advantage of the promoted network with the two above-mentioned districts. On the other hand, the same line of reasoning can be applied to the Central Corridor, where a district centered on the Manufacturing, Wholesale and Construction sector, namely Manjung, may benefit from complementarities with Kinta, which is characterized by a service oriented economy, underlined by its administrative role in the region. Once again, Perak Tengah, being considerably less developed than the other two districts, may take advantage of the stimulation of such network. The discourse is different for the Southern and Northeastern Corridors, where complementarities are lacking. As a matter of fact, the selected districts are characterized by a relatively high diversity which makes them operate as secluded systems. In other words, complementarities are completely bounded within specific districts, and there are no indications for potential cooperation and interconnectedness between them.

On a conclusive note, the analysis at the district level does not meet the criteria of a polycentric scenario in Perak. As a matter of fact, even if the investigation at the State level points out the diversity of the region as a whole, specialization is not observed when zooming into its sub-regional units. Referring to our Model Conceptualization, this excludes the presence of a polycentric urban structure, hinting at the Archipelago scenario. In a rather simplistic way, both at the regional and sub-regional level, Perak exhibits relatively high levels of variety in terms of GDP share, workforce distribution, number of establishments and incorporated Companies. Consequently, this is translated into relatedness being bounded within sub-regional units, without clear indication of potential interconnectedness and complementarities between them, driven by the ongoing process of diversification that characterizes the State and its administrative districts' economic configuration.

In other to complete the picture, the analysis is forwarded at the city level. This dimension is addressed to unravel the internal structure of districts, seeking to understand whether sub-regional entities are featured by a diverse or specialized set of cities and, in turn, unravel the intra-district dynamics that shape the functional system of Perak.

5.1.3 City level

The results computed and analyzed at the city level are built around the role of industries in the region. In fact, the specialization map presented is utilized to give a preliminary indication of the specific capabilities and relative competitive advantage of cities, as well as their potential complementarities in terms of economic sectors in loco. On the other hand, we utilize the number of incorporated firms from 1987 to 2018 to offer a validation of preliminary observations, as well as to produce a graphic representation of the economic (spatial) configuration of urban centers in Perak.

Economic Specialization

Firstly, the specialization map depicting cities' economic profiles is presented (Figure 26), accompanied by the Network structure based on relatedness measures (Figure 26).

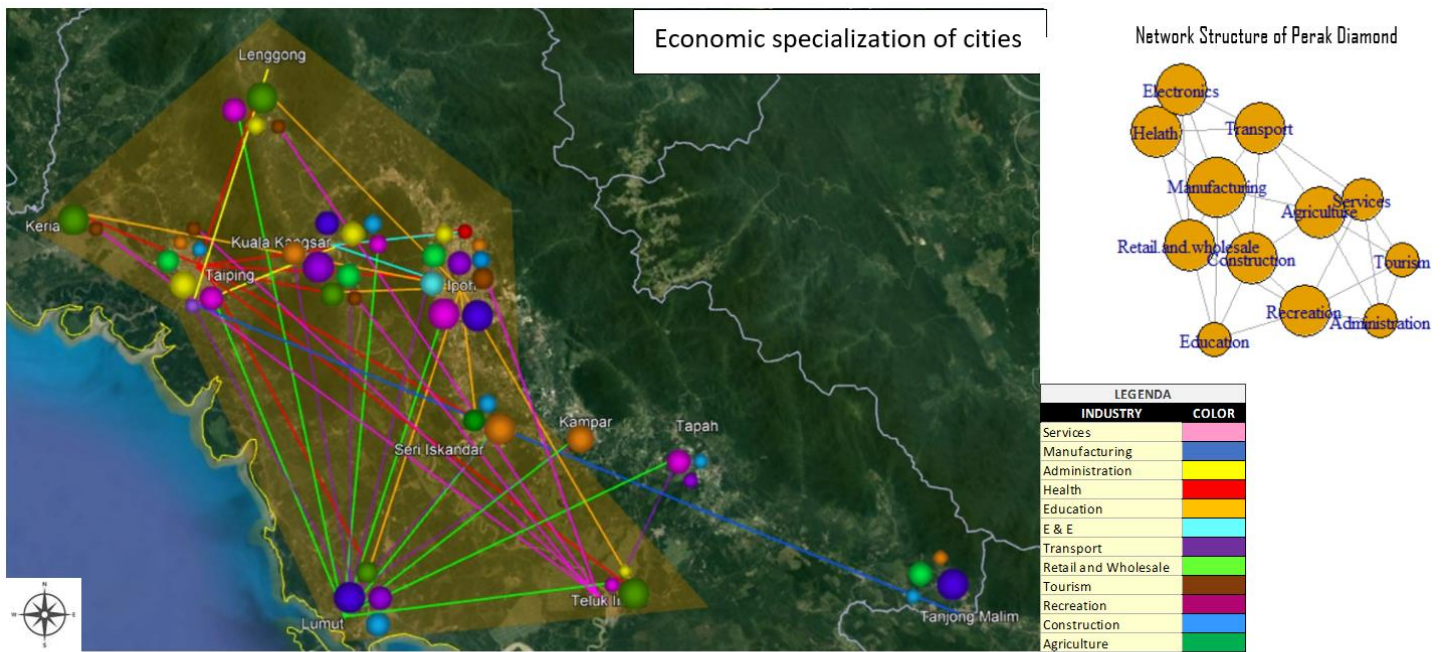


Figure 26: Economic specialization and interconnectedness of cities in the Perak Diamond & Network structure of Industry space

This map, based on secondary sources, points out the economic specialization of centers in 2016. It is observable that Taiping, Kuala Kangsar and Ipoh are cities characterized by a relatively diversified portfolio of industries. These cities are located at the core of the region in analysis, indicating a concentration of economic activities in the center of Perak. On the other hand, cities located at the peripheries, such as Lumut, Lenggong and Teluk Intan, are characterized by a relatively specialized portfolio of industries. By computing relatedness between sectors (see Appendix 12), graphically represented through the Network Structure (Figure 26), we are able to hypothesize links between a certain city and an economic sector which is not part of its current portfolio in the selected year. This means that, for example, Lumut is not specialized in Administrative activities but its structure of industries suggests a connection to this sector. Therefore, a line is drawn from Lumut to the closest cities in which the Administrative sector is found, as Tapah, Ipoh, Kuala Kangsar, Taiping, Teluk Intan and Lenggong.

By analyzing the Specialization Map and Network visualization, we are able to describe potential phenomena of borrowed size and agglomeration shadow. In a rather simplistic way, if a city is not specialized in a certain sector, and if that sector is related to the portfolio of industries in that city, the city is expected to borrow this sector from another city located in its close proximity. For instance, Lumut, which does not host the Education sector, is expected to borrow it from Kampar, Seri Iskandar, Ipoh and Taiping. On a general note, results suggest interconnectedness between periphery and the core of the Diamond. In fact, centrally located cities appear to be specialized in a wider range of sectors, making them structurally diverse. On the other hand, peripherally located cities are comparatively more specialized, and this leads to borrowing size dynamics between the two entities. From this starting point, we are able to assess the intensity of interconnectivity between urban centers, and, based on these connections, one is able to determine the grade of interdependencies among sub-regional units. As observable from the figure, the cities of Kampar, Tapah and Tanjung Malim are characterized by a relatively low number of connections with the rest of the regional system, raising doubts

concerning the boundaries of the so-called Perak Diamond. As a matter of fact, the Specialization map suggests the presence of a system which is smaller in size, excluding the Southern area of the Perak Diamond.

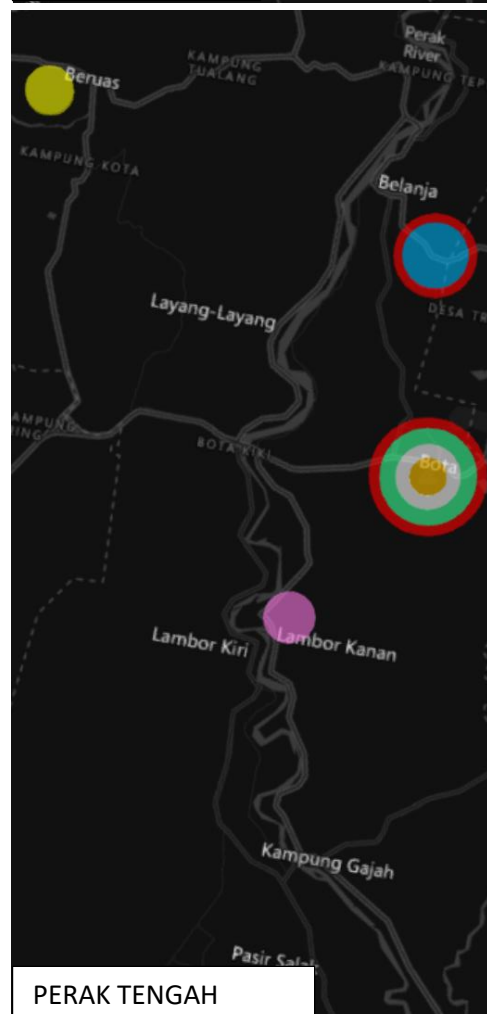
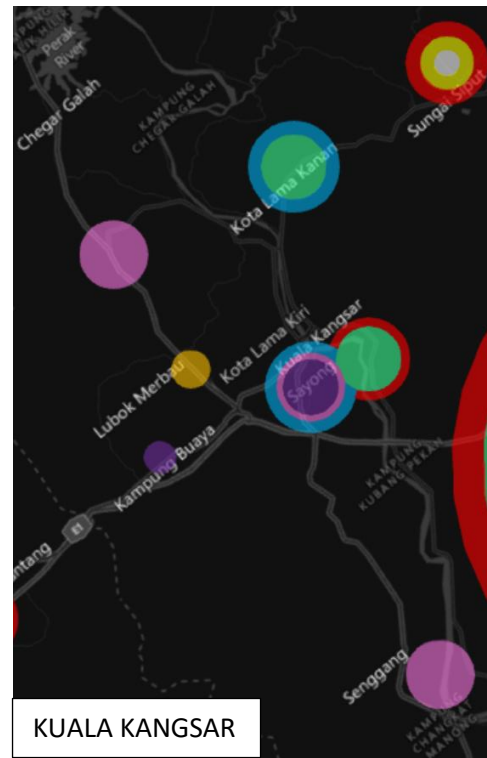
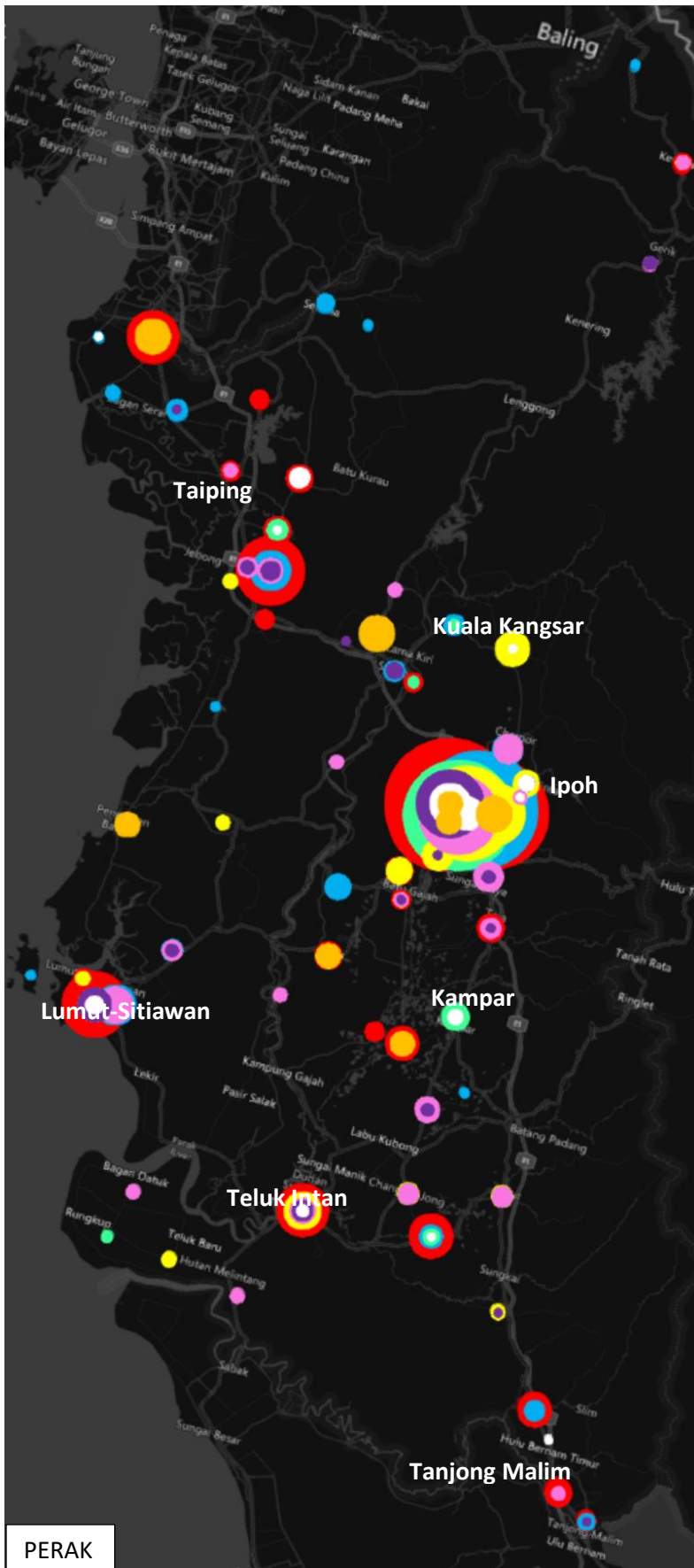
Even though the specialization of cities offers a visual overview of cities' economic profiles in Perak, this method is limited by its secondary sources. In fact, one is not able to have a comprehensive idea of the relative sizes of sectors in each city. Also, the data presented is static, meaning that it indicates the composition of industries' portfolios in cities in one point in time, underseeing the historical development and path-dependent processes that shape urban centers. To conclude, the specialization of cities is retrieved from documents that do not specify the sources of such specialization, raising uncertainties in terms of actual interconnectivities in the region. This limitation becomes an issue when we consider that the secondary sources utilized do not indicate the economic sectors present in smaller towns located around the main cities in the Perak region. This create a bias. In fact, one may think that main cities need to reach outside of their own district to exploit sectors that are not present in their portfolio, however, such cities might as well utilize these sectors if found in peripheral towns around them, drastically changing the described dynamics of borrowed size and agglomeration shadow. Further analysis is required. Because of this reason, the number of incorporated Companies from 1987 to 2018 in analyzed at the city level, so to confirm or reject the hypothesized scenario in the Perak regional system.

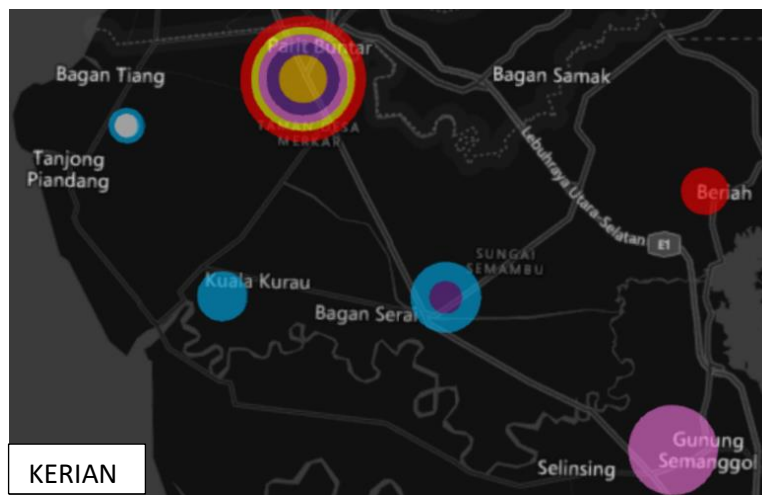
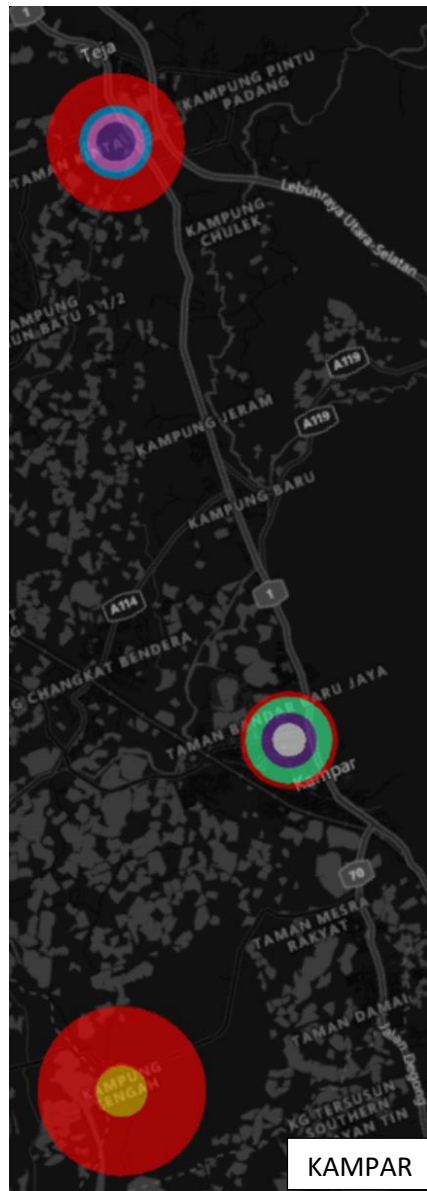
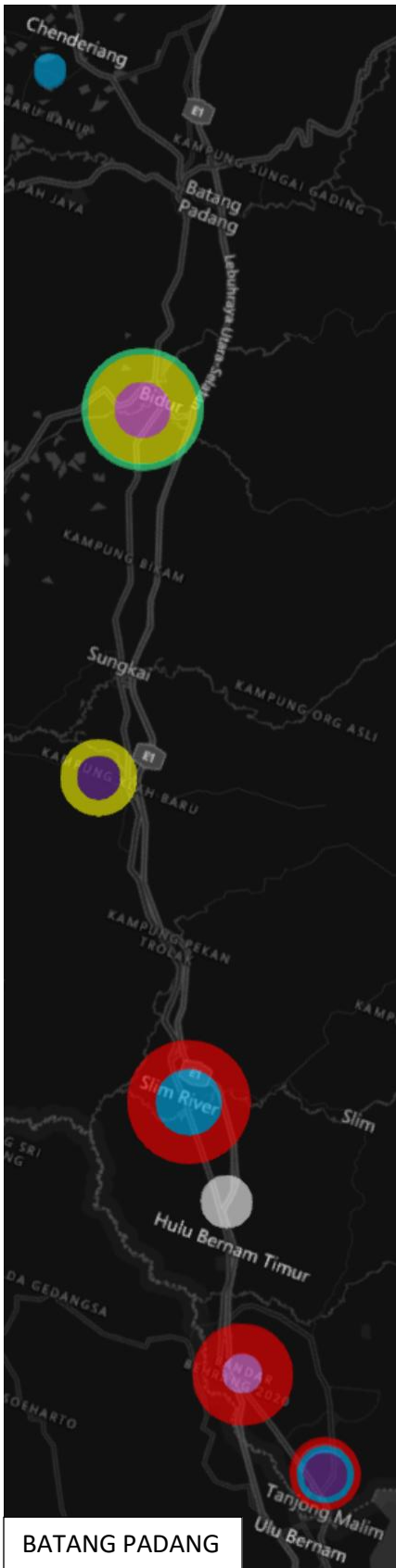
Incorporated Companies

Following the same line of reasoning utilized at the district level, the number of incorporated Companies in 1987, 1997, 2007 and 2018 is used to offer the reader an inclusive overview of the changing dynamics that characterize the spatial (economic) system of cities and towns in Perak. Firstly, graphs are produced to depict the distribution of Incorporated Companies in the region at the city level (see Appendix 13). Confirming our preliminary findings, Ipoh is found to be characterized by the highest concentration of incorporated firms in all of the selected time periods. The role of Ipoh as the central economic hub of Perak is visible in the distribution of Companies among the whole range of sectors, but, as anticipated, the functional dimension of our analysis must be controlled by its morphological side. In other words, the consistent differences in population sizes cannot be overlooked. Therefore, despite the uneven distribution of Companies in absolute terms, our Research focuses on the relative diversification or specialization of urban centers over time, allowing us to enter the discourse about urban configuration in terms of economic activities and interconnectedness.

Indeed, the analysis focuses on the visual representation of Perak's economic system. Four different maps are produced, each one depicting the distribution of incorporated companies in cities in 1987, 1997, 2007 and 2018 (see Appendix 14). These maps are compared to the specialization map, in order to spot similarities and divergences with outcomes retrieved from secondary sources, further verify the findings. Also, the visual analysis gives a comprehensive interpretation of the interaction between industries' relatedness and urban structure at different locational dimensions.

It follows the map relative to the distribution of Incorporated Companies in Perak in 2018 at the city level, accompanied by additional maps zooming into the sub-regional units of the State (Figure 27).





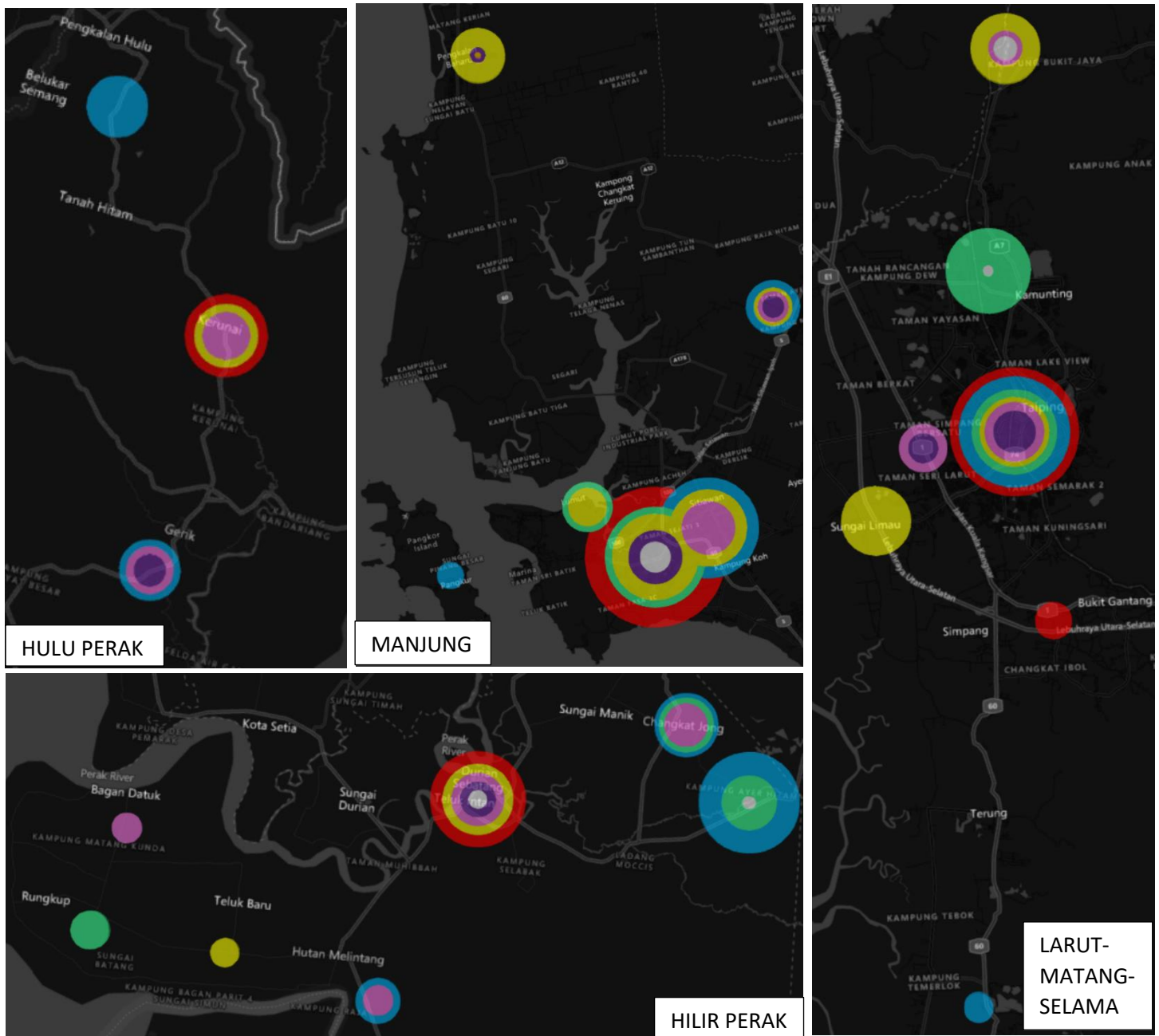


Figure 27: Incorporated Companies per sector, regional and sub-regional maps, 2018 (SSM, 2019)

These maps represent the conclusive and most interesting finding of the Research. In fact, following the main Research question, we are able to assess the characteristics of the urban configuration of Perak. After stating that, at the regional level, Perak presents the attributes of a diversified system, one may expect its cities to be relatively specialized in order to result in a polycentric urban system. Nevertheless, as observable from the figures, the spatial (economic) dynamics of Perak over time are more complicated than one may think. Not only a shift from a regional economy centered around the primary sector to a service-oriented one is noted, but, actually, the findings at the city level tend to validate the archipelago scenario hypothesized in the analysis of Perak at the district level. While in 1987 urban centers appear to be relatively specialized, the picture drastically changes in a thirty years period. In the following years, in fact, the main cities per district and the urban centers in their vicinity undergo a process of diversification that changes the regional landscape of Perak. Once specialized agglomerations of cities become increasingly diversified in a wider range of economic sectors. This results in drastic changes in terms of interconnectedness and regional urban configuration. As mentioned in the Theoretical Framework section, a polycentric system needs specialized centers, but this is not the case for Perak anymore. In 2018, the picture indicates that the districts act as diversified systems characterized by more specialized cities, and this results in relatedness to be bounded inside the district itself. In other words, cities do not need to cross the districts' boundaries to exploit economic sectors that were not present within their borders in the precedent time frame. While in 1987 it was necessary for certain locations to expand their activities to cities located within the whole region, in 2018 cities can find a complete set of economic portfolios within the districts' boundaries. This observation is crucial, as it indicates the characteristics of an archipelago system. Even though the visual representations may indicate the presence of a monocentric system, built around Kinta and, more specifically, Ipoh, this is misleading. In fact, the dominant role of Ipoh is only limited to its size. When looking at the grade of diversification of urban centers, Ipoh does not have a consistent competitive advantage over secondary urban hubs, such as Taiping or Lumut. The composition of their economic portfolio presents striking similarities, suggesting that cities in Perak have a tendency not to leverage local capabilities to develop tailored competitive advantages, but rather prefer to emulate the successful cities, in this case Ipoh, in order to obtain a more complete set of industries in their territory.

After describing the regional urban configuration, we are able to zoom into the specific districts to have a closer look at the economic (spatial) distribution of Companies within sub-regional units. It is observed that districts appear as diversified systems characterized by relatively specialized centers, validating the hypothesis of an archipelago system. In this kind of configuration, the cities within the specific districts exploit the diversity of sectors between each-others, negatively affecting the cooperation with locational units located in other districts. Also, most districts are characterized by a main urban center surrounded by secondary cities, resulting in a monocentric structure. As a matter of fact, for instance, Kinta is featured by a diversified center, Ipoh, surrounded by more specialized ones. The same goes for Larut-Matang-Selama, characterized by a central node, Taiping, where diversity is observed, and peripheral smaller and relatively specialized centers. This implies that each "island" in the archipelago system functions as a monocentric system, where peripheral nodes exploit the centrality and nodality of the main urban center serving it through their specialized sectoral composition. This outcome finds an explanation in the geographical distribution of specialized clusters. In fact, for instance, Kamunting hosts a rubber cluster that makes use of the variety of services in Taiping.

To conclude, the urban configuration of Perak appears as an archipelago system, where districts develop according to a hierarchical system. In a rather simplistic way, secluded islands of cities are characterized by a centralized system,

where secondary cities within districts serve to complement the sectors that are lacking in the main city within the specific district.

Interestingly, the pictures depicted by the specialization map on one hand and the distribution of incorporated Companies on the other hand are dissimilar. While the specialization map was suggesting the presence of borrowed size and agglomeration shadow phenomena between main urban centers in Perak, the distribution of Companies indicate the irrelevance of these interconnectedness. This is key to explain the already-mentioned State-based mentality in the economic (spatial) structure of Perak, where Government agents plan regional and urban structures in a hierarchical way, undervaluing the role of secondary urban centers characterized by specific economic advantages. This Research argues that the specialization map, realized utilizing secondary sources retrieved from Government documents, does not accurately describe the effective economic scenario of Perak. On the contrary, the more in-depth analysis conducted at the sub-district level is of supplementary relevance and underlines the absence of a tailored-specific masterplan at the Government level that encompasses the totality of geographical dimensions in Perak.

Following this line of reasoning, the Research proceeds by validating such argumentation with the addition of a qualitative investigation at the firm and Government level.

5.2 Qualitative Analysis

In the wake of the limitations associated with the indicators used for the quantitative analysis macro section, the Research seeks to enrich findings through qualitative methods. By conducting interviews with major companies and Governmental agencies, we are able to verify whether the archipelago system is indeed a reality in Perak. As specified in the Theoretical framework, the agents influencing the urban configuration of the region are identified as economic sectors, investigated through case-specific firms and institutions. Therefore, the following results section has to be seen as the last step towards the validation of the Research's findings.

5.2.1 Firm level

To better guide the reader through the array of interviews conducted, this chapter starts with a table presenting the interviews carried out with Companies' representatives (Figure 28) (see Appendix 15 for full interviews). Before concluding with a summary pointing out the main observations and their role as validators of quantitative outcomes, the section presents a table containing the interview conducted with PKNP (Figure 29).

LEGENDA

A: Kuala Lumpur Kepong Berhad

B: Malayan Flour Mills Food manufacturing

C: Finisar Malaysia Sdn Bhd

D: Megah Transport Sdn Bhd

E: Ecoauto Assembly Plant Sdn Bhd

	<i>LOCATION CHOICE</i>	<i>INTER-FIRM CONNECTIVITY</i>	<i>SPATIAL ECONOMIC CONFIGURATION</i>	<i>INTEGRATION AND MOBILITY</i>
A	<p>HQ in Ipoh, attempting to attract investments and stimulate economic activity</p> <p>Rubber manufacturing activities mainly based around the KL-Kepong Rubber Product Sdn. Bhd. factory</p> <p>Secondary office in KL, trying to exploit cluster and infrastructure advantages</p>	<p>Cooperation with United Plantations in Teluk Intan</p> <p>No evidence of actual inter-firm connections relations between firms in Perak</p> <p>Relations only found in the Members of Chamber and Association of Manufacturers</p> <p>Connections to other urban centers within the region are almost non-existing</p> <p>Lumut Port, unreliable and lacking in appropriate volume, is not seen as a regional asset</p> <p>Operations in KL allow to operate in a more interconnected network</p>	<p>Perak as a conglomerate of mini economies, with a clear division among districts, both in terms of economic sectors and workforce movement</p> <p>Absence of clear network connectivity in Perak, both inter-firms and inter-cities, attributable to the lack of an economic masterplan</p> <p>The State does not benefit from a strong leadership and there are no promoting policies by the Government</p> <p>The absence of tailored policies and a State-based mentality overlooks the interconnectedness of centers and their spatial economic structure</p> <p>Perak lacks in terms of a stable industrial base</p> <p>Centers in Perak lack in expertise Perak's economy finds its roots in the advantage associated with the abundance of natural resources in the territory, but the absence of alternative sources of income negatively affected the growth of Perak in the long-term</p> <p>The diversification process at the State level is evident</p> <p>There is an urgent duplication issue at the sub-regional level</p> <p>Urban centers, instead of leveraging specific competitive advantages, invest in mainstream activities, such as the tourism industry Diversified sub-regional units lack in specific areas of expertise and tend to align to each other's over time in terms of sectoral composition</p>	<p>Educational institutes are based outside of Perak, and so are jobs</p> <p>Despite the diseconomies of higher living costs and congestion, the quality of amenities and jobs, workforce migration towards Kuala Lumpur is undeniable</p> <p>Brain-drain phenomenon, affecting KLK in the identification of suitable professional workers and laborers for their factories</p> <p>Labor force is bounded within specific districts, as the majority of employees comes from the Kinta district</p>

B	<p>Based in Lumut. Initial location choice related to the specific assets associated with the access to the port facility and cheaper costs of land</p> <p>No direct use of Lumut port because of its insufficient size and density</p> <p>Own Jetty, utilized to export products to South-East Asian countries</p>	<p>Companies located in Ipoh are utilized for packaging, as the costs of operations are significantly lower.</p> <p>Basic engineering services located in Ipoh are utilized.</p> <p>Support services in Ipoh are chosen based on proximity and cost advantages, which decreases the burden of demobilization</p>	<p>Absence of a sufficient level of specialization of urban centers</p> <p>Lumut Port is not the preference of many Companies, that choose to make use of private jetties or Port Klang, advantaged by its mass and efficiency</p>	<p>Majority of employees live close to Lumut, but the great majority of the specialized workforce is represented by expats</p> <p>Cooperation with specialists from Kuala Lumpur and Johor is much more common because of their advantages in terms of expertise and dedicated knowledge, which overcome relatively higher costs associated with distance</p>
C	<p>Based in the Kinta free Industrial zone</p> <p>Structured as a centralized system which reflects the location of activities' portfolio</p> <p>Location choice driven by tax exemption benefits and cheaper land prices, which balanced the insufficiency of other locational advantages in the region</p>	<p>Suppliers mainly located in China</p> <p>98% of goods produced are exported overseas to be sold to telecommunications companies such as Cisco</p> <p>International-oriented company, reflected in the poor inter-firm connections within Perak</p> <p>Local firms are used mainly for packaging services, because of lower costs and transit time</p> <p>cooperation with Tigges (screws producer) located in the same industrial zone, that produces screws</p> <p>No significant partnerships in Perak.</p> <p>Partners in Penang, used for subcontractors</p> <p>Use of external couriers, such as FedEx and UPS, used to send cargos to airports in Kuala Lumpur and Penang.</p> <p>0.5% of products are shipped by sea, the rest is moved through airplanes. Lumut not considered as a viable distribution option</p>	<p>Lack of expertise and mass in Perak, where potential subcontractors are not competitive, also in terms of pricing</p> <p>Distribution facilities in Perak are not suitable. Preference for Penang and Kuala Lumpur as distribution hubs</p> <p>Self-sufficient districts in terms of support services and employment recruitment</p>	<p>Use of local labor recruited from a 50-60 km range</p> <p>To facilitate employees' movement, a shuttle bus is utilized</p> <p>Specialized workforce, such as support engineering services, is employed from the Kinta district, considering lead time and distance as crucial factors</p>
D	<p>Located in the Kamunting Industrial Estate. Decision is associated with tax benefits</p>	<p>Main function is related to the transportation of products for Companies located in the same Industrial zone</p> <p>Main clients are Latexx, Professional Latex, Eco Medi Glove and Riverstone.</p> <p>Goods are transported by containers on trucks and sent to Penang and Port Klang</p> <p>Absence of connections to the Lumut Port for reasons related to efficiency and volume</p>	<p>Scarcity of inter-firm and inter-district connectivity in Perak.</p>	<p>Workforce is completely recruited from Taiping and Kamunting</p>
E	<p>Located in the Industrial Estate of Kamunting. Location choice is driven</p>	<p>Products are exported to a variety of Asian countries</p>	<p>Perak lacks in terms of appropriate specialized services</p>	<p>Employees come from the Larut-Matang-Selama district</p>

by costs advantages of land and materials	Suppliers are located outside of Malaysia, mainly in China	Districts function as separate entities for what concerns workforce availability	The great majority of employees resides in Taiping
Government assures the Company import fee duty exemptions	Malaysian suppliers, which constituting a minor percentage of the total suppliers, are located outside of Perak	Interconnectedness with suppliers, customers and other Companies is mainly found outside of Perak	
	No cooperation with other Companies, also in terms of transportation		
	Own transportation system		
	Exclusion of any interconnectedness scenario		

Figure 28: Companies' Interviews

After presenting the interviews carried out with Companies, the Research introduces the Government actor: PKNP.

PKNP is the investment arm of district Government. In the determination of Industrial Estates' location and composition, Mr. Goradial states that PKNP is the first of four main actors. The second actor involved are private Companies which are established in the designated Industrial Estates. These private agents apply for land which they can subsequently purchase, shaping the development and direction in which the Industrial Estate advances. The third actor are local councils, involved in the maintenance of Industrial estates, financed with taxes. The fourth actor is the State, which owns the totality of the land. It follows that industrial land is indirectly governed by PKNP, making this agency a key player in the spatial economic configuration of Perak.

	<i>STRATEGY FOR INDUSTRIAL DEVELOPMENT</i>	<i>REGIONAL DEVELOPMENT</i>	<i>SUB-REGIONAL LEVEL</i>	<i>INTER-FIRM AND INTER-CITY CONNECTIVITY</i>
PKNP GROUP	<p>Targets districts where the highest potential for economic growth is identified</p> <p>Districts connected to the economic sector with most development potential and population growth are selected for the stimulation of Industrial activities</p> <p>Four main indicators: economic potential, urban concentration, population and supporting services in loco.</p> <p>Identification of Kinta, Manjung, and Larut-Matang-Selama. Manjung is advantaged by the presence of well-developed infrastructure and port facility, translated into transport and support services benefits</p>	<p>Perak's economy experiences a need to diversify on a State level</p> <p>Diversification process starts with the advantages in terms of natural resources, spurred by improved transportation networks and educational levels</p> <p>Requirement on the State-level to diversify into other downstream manufacturing activities, attempting to anticipate the depletion of natural resources</p>	<p>Districts in Perak need to diversify and find new sources of income</p> <p>Diversification objective at the sub-regional level has implications for the economic spatial structure of districts, which become self-sustaining</p> <p>Districts, once characterized by relatively specialized economic activities, are converging towards a more similar structure, rendering the cooperation between each other's unnecessary</p> <p>Lumut as an example of such self-sufficiency. Once specialized in the manufacturing and transportation industry, it now hosts banking services, maintenance and break-down support activities, making it irrelevant to refer back to Ipoh</p> <p>Ipoh lacks in specialized support services Lack of expertise relative to specific sub-regional entities in Perak</p> <p>Specialized hubs are related to natural resources. Also, the fishing industry in Pangkor Island and the food manufacturing in Lumut remain specialized, motivated by cultural and historical reasons</p>	<p>Apart from transportation from Taiping and Ipoh to Lumut, no real connections at the sub-regional level are evident in the economic structure of Perak.</p> <p>Connections external to the region are more frequent and driven by the research of specialized capabilities</p> <p>A relatively large number of engineers employed in the neighboring region of Penang are from Taiping. The real connections in Perak are only visible within districts themselves</p> <p>The movement of manpower is evident, meaning that people tend to converge towards bigger urban centers located in their proximity to exploit better working opportunities</p>

Figure 29: PKNP's interview (Goradial Singh Ban Singh [Manager])

5.2.2 Insight knowledge from economic and institutional agents

The several interviews conducted show commonalities that delineate the regional scenario in Perak in terms of urban configuration and inter-firm connectivity between and within specific locational dimensions. In particular, we are able to investigate the specialization and diversification of industries from a firm perspective, enriching the analysis with the view of Governmental agents.

Firstly, it is deduced that the archipelago hypothesis derived from the quantitative analysis of the Research can be indeed validated. In fact, only a limited degree of inter-firm cooperation is observed. Specifically, the only evident cooperation happens in terms of transportation purposes through the use of the port facility in Lumut, even if not as common as one may expect. The reason stays in the limited mass of such facility, that leads to the establishments of alternative solutions such as private jetties and temporary occupancy licenses, posing a navigational and competition threat. Similarly, services in Ipoh are not exploited by firms located in other urban areas because of a lack of expertise. Thus, companies tend to utilize relatively specialized labor and skills located in their vicinity, when available, or alternatively from the neighboring States of Penang and Kuala Lumpur that, as anticipated, offer a much greater level of expertise and specialization. This advantage overcomes the higher costs dictated by distance. The same trend is observed in terms of labor force. In fact, companies tend to make use of local employees living within the district. When an adequate workforce is not available in loco, Companies prefer to recruit human capital from other States rather than other districts in Perak. This, once again, is a sign of poor expertise and lacking specialization. Zooming into the urban structure of sub-regional units, or districts, it is noticed that the quantitative observation of a monocentric system is supported. In fact, interviews confirm that peripheral cities within districts show cooperation with central urban nodes, leveraging sectoral complementarities. Such complementarities are derived from the specialized structure of smaller peripheral centers against the diversified structure of central nodes.

The configuration of such scenario is mainly attributable to the State-oriented mentality characterizing Perak. In other words, while a need for diversification at the regional level is recognized by firms and Governmental bodies, sub-regional units' sectoral composition is overlooked. In a rather simplistic way, districts are featured by an increasingly diversified portfolio of industries, resulting in a convergence of their economic structure rather than a specialization of centers. As explained in the theoretical body of our Research, this implies the exclusion of the Polycentricity scenario. The absence of a clear leadership and masterplan from the Government is certainly one major issue in this regard. Consequently, the result is an archipelago system, where districts act as self-sufficient islands that do not need to rely on each other's to complement lacking capabilities in terms of economic sectors' development and workforce specialization. In turn, when zooming into specific districts, their structure typically presents a relatively diversified larger center surrounded by relatively specialized peripheral centers that serve as complements for the main one. Therefore, one may argue that the micro-structure of districts is presented in the form of a monocentric functional configuration. Nevertheless, the lacking mass and expertise both in major and minor centers is the source of the incompatibility of a functional polycentric scenario at the regional level for Perak. While the Government argues that this may enhance the resilience of districts, their economic renewal and prosperity is in doubt.

6. Conclusion and Reflection

The analysis conducted in the Research defines the functional characteristics of the spatial economic urban configuration of Perak, in Peninsular Malaysia. Driven by the recognition that Peninsular Malaysia's urban system and its main cities face several challenges in respect of spatial structure, the Research unravels the shortcomings of a hierarchical approach at the regional and sub-regional level. Following insights of the relevance to performance of dimensions beyond city size, the Research emphasizes the role of functional features to enhance mass, connectivity and integration. Shifting the focus from independent settlements' characteristics to the interconnectedness between them, we are able to define a complementary investigation to the 'Malacca Straits Diagonal' (FundacionMetropoli/ThinkCity, 2018).

Dynamics of specialization and diversification of sectoral composition over time are scrutinized and linked to the interactions within and between economic portfolios characterizing locational dimensions at several geographical levels. Ultimately, the definition of the urban configuration of Perak is constructed and verified through a multidisciplinary approach, bundling quantitative and qualitative analytical methods.

Referring back to the Model conceptualization of the Research, it is observed that a process of diversification of the economy of Perak in the last thirty years is undeniable. Once characterized by an absolute focus on Mining and Agriculture, the economy of the region is shifting towards a service-based system, where the portfolio of industries at the regional level is increasingly widening. Following a path-dependent development, the totality of the multitude of indicators used point to the same direction. Shares of GDP, workforce distribution and the geographical allocation and sectors' size of Incorporated Companies from 1987 to 2018 indicate a diversified economic structure at the regional level. Such findings are further verified by interviews carried out with significant private and government actors, confirming quantitative observations.

Nevertheless, the analysis at the regional level is not sufficient to estimate the structure of the urban configuration of Perak. Thus, sub-regional units, defined as administrative districts, are investigated. Quantitative findings indicate an unfitting configuration to the polycentric vision entailed in the Malacca Straits Diagonal report (2019). As a matter of fact, specialization is not observed, excluding the presence of a polycentric urban structure and hinting at the Archipelago scenario. In a rather simplistic way, both at the regional and sub-regional level, Perak exhibits relatively high levels of variety in terms of GDP share, workforce distribution, number of establishments and incorporated Companies. Consequently, this is translated into relatedness being bounded within sub-regional units, without clear indication of potential interconnectedness and complementarities between them, driven by the ongoing process of diversification that characterizes the State and its administrative districts' economic configuration.

Zooming into the internal spatial economic structure of districts, urban settlements' economic characteristics and dynamics are investigated. It is found that districts in Perak develop as secluded islands of cities characterized by a centralized system, where secondary urban centers within districts serve to complement the sectors that are lacking in the main city within the specific district. This implies the absence of interconnectivity between sub-regional units. Indeed, such connectivity remains constrained within the boundaries of sub-regional units, and it is only evidenced from secondary nodes towards main nodes. This scenario is particularly evident in the districts that, from a Government angle, are identified as areas with the highest development potential: Kinta, Manjung and Larut-Matang-Selama.

The delineated configuration is depicted in Figure 30, where it is observable how sub-regional systems, or districts, act as separate entities featured by specialized secondary urban centers serving a diversified node, dominant both in terms of nodality and centrality. This structure is therefore outlined along monodirectional connections converging towards a single city in each specific sub-unit. When the lens is shifted from sub-regional units to the regional context, a diversified picture emerges, in line with the characteristics observed in the analysis at the State level.

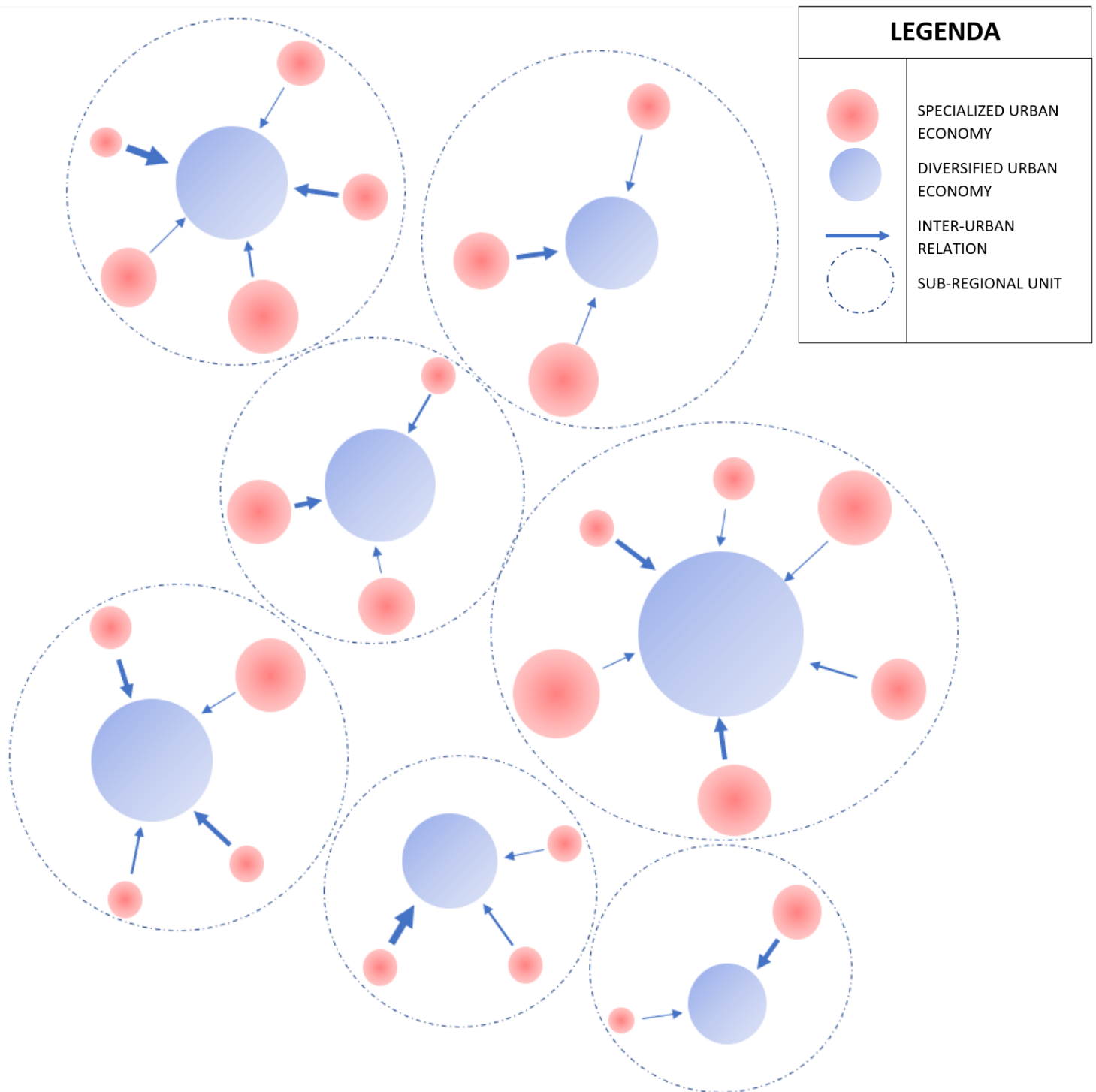


Figure 30: Urban configuration of Perak (author's own illustration)

Central in our reflection is the theme of performance, that is, productivity, achievable through the enhancement of mass of the Perak Diamond so to fill the void between the conurbations of Penang and Greater Kuala Lumpur. In this respect, a major issue in the urban configuration of Perak is identified in the lack of specialization in the economic structure of the region, observable at both regional and sub-regional level. This deficiency of expertise is a direct consequence of the dynamics of diversification observed, that negatively affects the needed increase in mass of the Perak Diamond. As a matter of fact, even if the diversified economic portfolio of the region may indeed spur the State's resilience, it prevents the creation of tailored-specific skills and capabilities that could constitute a source of competitive advantage in the economic system of Peninsular Malaysia. Explicitly, it results in the inhibition of the attractive potential of Perak in terms of investments and employment, which remain secluded inside the region itself. Intuitively, the lack of specialization is translated into a poor potential in terms of mass, as human capital and firms are not enticed by the economic structure and development potential of the Perak Diamond. The absence of highly specialized economic hubs in correspondence of sub-regional units is mainly attributable to a State-based mentality, which recognizes a need for diversification at the regional level but overlooks the sectoral composition of districts' portfolios. Not only this is observable in insufficient inter-city and inter-firm connectivity in the Perak Diamond, but it also results into a relatively stronger interconnectedness with cities located outside of Perak's boundaries, such as Kuala Lumpur and Penang, that offer a higher grade of specialization and expertise.

Ultimately, the potential for a polycentric scenario, in functional terms, is highly doubted and raises several uncertainties. In this Research, it is argued that the enhancement of intra-regional connectivity in Perak is not a feasible option. On the contrary, gains in mass and consequent performance may benefit from the stimulation of extra-regional interconnectivity towards the conurbations of Penang and Kuala Lumpur. Nevertheless, in this scenario, the decline of secondary cities in Perak represents a serious threat. In fact, the increase in mass and expertise would be mainly focused around Ipoh which, nowadays, can be argued to be the central node of Perak. Consequently, economic activities would converge towards this central node, negatively affecting the role of peripheral centers.

6.1 Limitations and future investigations

The limitations of the Research, anticipated in the main body of the investigation, are mainly associated with a lack of appropriate data at the lowest locational level. In fact, information for specific cities are hardly identifiable. This issue is overcome through the use of secondary sources, such as Governmental reports, and proxy measures, as the number of incorporated Companies utilized to describe dynamics of economic growth and sectoral change. On a positive note, the abundance of data at the State level allowed to delineate a very specific scenario of the economic composition of Perak. A second major limitation refers to the industrial classification utilized, which only includes macro-sectors. This negatively affects the precision of relatedness measures and, most importantly, overlooks the interconnectivity of micro-sectors within macro categories. Considering the presence of relatively specialized hubs in certain locations, such as the rubber manufacturing center in Kamunting, the analysis of micro sectoral connectivity would significantly enrich the picture depicted, possibly altering the dynamics described.

Even though this Research significantly contribute to the understanding of the urban configuration in the Perak

Diamond, the suggestion for future studies is to enrich the investigation through the use of a larger variety of city-level variables and economic sectors' classification.

7. Bibliography

- Asheim, B. T., Boschma, R., & Cooke, P. (2011). Constructing regional advantage: Platform policies based on related variety and differentiated knowledge bases. *Regional studies*, 45(7), 893-904.
- Atkinson, A. B., & Stiglitz, J. E. (1969). A new view of technological change. *The Economic Journal*, 79(315), 573-578.
- Balland, P. A., Boschma, R., & Frenken, K. (2015). Proximity and innovation: From statics to dynamics. *Regional Studies*, 49(6), 907-920.
- Balland, P. A., Boschma, R., Crespo, J., & Rigby, D. L. (2018). Smart specialization policy in the European Union: relatedness, knowledge complexity and regional diversification. *Regional Studies*, 1-17.
- Balland, P. A., Rigby, D., & Boschma, R. (2015). The technological resilience of US cities. *Cambridge Journal of Regions, Economy and Society*, 8(2), 167-184.
- Balland, P. A. (2017). Economic Geography in R: Introduction to the EconGeo package.
- Balland, P.A. (2017) Economic Geography in R: Introduction to the EconGeo Package, Papers in Evolutionary Economic Geography, 17 (09): 1-75
- Barton, B. (1978) The creation of centrality, *Annals of the Association of American Geographers*, 68, pp. 34-44.
- Boschma, R. (2014). Constructing regional advantage and smart specialisation: Comparison of two European policy concepts. *Scienze Regionali*.
- Boschma, R. and Giannelle, C. (2014) Regional Branching and Smart Specialisation Policy, JRC Technical Reports, S3 Policy Briefings No. 06/2014, European Commission
- Boschma, R., & Iammarino, S. (2009). Related variety, trade linkages, and regional growth in Italy. *Economic geography*, 85(3), 289-311.
- Boschma, R., Minondo, A. and Navarro, M. (2013), 'The emergence of new industries at the regional level in Spain. A proximity approach based on product-relatedness', *Economic Geography*, 89 (1), 29-51.
- Burgalassi, D. (2010). Defining and measuring polycentric regions: the case of Tuscany.
- Burger, M. J., de Goei, B., Van der Laan, L., & Huisman, F. J. (2011). Heterogeneous development of metropolitan spatial structure: Evidence from commuting patterns in English and Welsh city-regions, 1981–2001. *Cities*, 28(2), 160-170.
- Burger, M., & Meijers, E. (2012). Form follows function? Linking morphological and functional polycentricity. *Urban studies*, 49(5), 1127-1149.

- Camagni, R., & Capello, R. (2004). The city network paradigm: theory and empirical evidence. *Contributions to Economic Analysis*, 266, 495-529.
- Christaller, W. (1933) Die Zentralen Orte in Süddeutschland. Jena, Gustav Fischer.
- Cohen, W. M., & Levinthal, D. A. (1990). Absorptive capacity: A new perspective on learning and innovation. *Administrative science quarterly*, 35(1), 128-152.
- Dataset : Data Asas Negeri Perak. (2016, July 25). Retrieved from <http://jpbd.perak.gov.my/jpbd/index.php/mengenai-kami/dataset/435-dataset-data-asas-negeri-perak>
- Dosi, G. (1982). Technological paradigms and technological trajectories: a suggested interpretation of the determinants and directions of technical change. *Research policy*, 11(3), 147-162.
- DOSM. (n.d.). Department of Statistics Malaysia Official Portal. Retrieved from <https://www.dosm.gov.my/v1/>
- Duranton, G., & Puga, D. (2000). Diversity and specialisation in cities: why, where and when does it matter?. *Urban studies*, 37(3), 533-555.
- Federal Department of Town and Country Planning Peninsular Malaysia, Ministry of Housing and Local Government (2016), National Urbanisation Policy 2.
- Federal Department of Town and Country Planning Peninsular Malaysia, Ministry of Housing and Local Government (2006), National Urbanisation Policy.
- Federal Department of Town and Country Planning Peninsular Malaysia, Ministry of Housing and Local Government (2016), National Physical Plan-3 2015-2020.
- Federal Department of Town and Country Planning Peninsular Malaysia, Ministry of Housing and Local Government (2016), National Physical Plan-3 2015-2020.
- Frenken, K., Oort, F. V., Verburg, T., & Boschma, R. (2004). Variety, employment and regional development in the Netherlands.
- Frenken, K., Van Oort, F., & Verburg, T. (2007). Related variety, unrelated variety and regional economic growth. *Regional studies*, 41(5), 685-697.
- Fundacion Metropoli (Madrid)/Thinkcity (Penang), Reconceptualizing Malaysia's Urban Future. A territorial vision for Peninsular Malaysia. Analysis Document. Draft V6. July 2018.
- Garcia-López, M. À., & Muñiz, I. (2013). Urban spatial structure, agglomeration economies, and economic growth in Barcelona: An intra-metropolitan perspective. *Papers in Regional Science*, 92(3), 515-534.
- Geografia. (2015). *Perak: Baseline Study (Draft)*. Retrieved from <file:///C:/Users/giaco/Desktop/Malaysia%20docs/Draft%20Perak%20Baseline%20Study%202015%2030.7.15.pdf>

- Glaeser, E. L., Kallal, H. D., Scheinkman, J. A., & Shleifer, A. (1992). Growth in cities. *Journal of political economy*, 100(6), 1126-1152.
- Green, N. (2007). Functional polycentricity: a formal definition in terms of social network analysis. *Urban Studies*, 44(11), 2077-2103.
- Gutzmer, A. (2015). *Urban Innovation Networks: Understanding the City as a Strategic Resource*. Springer.
- Hanneman, R. A., & Riddle, M. (2005). *Introduction to social network methods*.
- Hausmann, R. and Hidalgo, C.A. (2010), 'Country diversification, product ubiquity, and economic divergence', CID Working Paper No. 201, Center for International Development at Harvard University.
- Hausmann, R., & Klinger, B. (2007). *The structure of the product space and the evolution of comparative advantage*(No. 146). Center for International Development at Harvard University.
- Hidalgo, C. A., Balland, P. A., Boschma, R., Delgado, M., Feldman, M., Frenken, K., ... & Neffke, F. (2018, July). The principle of relatedness. In *International conference on complex systems* (pp. 451-457). Springer, Cham.
- InvestPerak, 2016, Briefing on the State of Perak, Ipoh
- Jabatan Perancangan Bandar Dan Desa Perak, 2008, Perak State Structure Plan 2020, Ipoh
- Jacobs J (1969) *The economy of cities*. Random House, New York
- Kloosterman, R. C., & Lambregts, B. (2001). Clustering of economic activities in polycentric urban regions: the case of the Randstad. *Urban studies*, 38(4), 717-732.
- Koridor Utara/Perak State Economic Planning Unit, 2014, Greater Kamunting Transformation Blueprint, Perak
- Limtanakool, N., Dijst, M., & Schwanen, T. (2007). A theoretical framework and methodology for characterising national urban systems on the basis of flows of people: empirical evidence for France and Germany. *Urban Studies*, 44(11), 2123-2145.
- Lukermann, F. (1966) *Emperical Expressions of Nodality and Hierarchy in a Circulation Manifold*, East Lakes Geographer, 2, pp. 17-44.
- Lundvall, B. Å. (2002). *Innovation, growth, and social cohesion: the Danish model*. Edward Elgar Publishing.
- Malaysian Department of Statistics, 2010, Population and Housing Census 2010, Kuala Lumpur
- Malaysian Department of Statistics, 2012, Data Bank, Kuala Lumpur
- Markusen, A. and Schrock, G. (2006) The distinctive city: divergent patterns in growth, hierarchy and specialisation, *Urban Studies*, 43, 1301-1323.

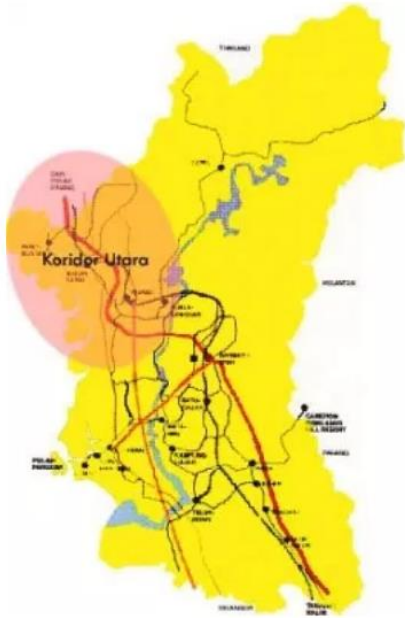
- Marshall, J.U. (1989) *The Structure of Urban Systems*. Toronto: University of Toronto Press.
- Meijers, E. (2007). From central place to network model: theory and evidence of a paradigm change. *Tijdschrift voor economische en sociale geografie*, 98(2), 245-259.
- Meijers, E. J. (2007). *Synergy in polycentric urban regions: complementarity, organising capacity and critical mass* (Vol. 13). IOS Press.
- Meijers, E. J., Burger, M. J., & Hoogerbrugge, M. M. (2016). Borrowing size in networks of cities: City size, network connectivity and metropolitan functions in Europe. *Papers in Regional Science*, 95(1), 181-198.
- MIDA. (n.d.). MIDA | Malaysian Investment Development Authority :. Perihal MIDA. Retrieved July 26, 2019, from <http://www.mida.gov.my/home/>
- Mun, H. W. (2007). Malaysian Economic Development. Issues and Debates. *Journal of Islamic Marketing*, 2 (5).
- Murmann, J. P. (2003). *Knowledge and competitive advantage: The coevolution of firms, technology, and national institutions*. Cambridge University Press.
- Neffke, F. (2009), *Productive Places. The Influence of Technological Change and Relatedness on Agglomeration Externalities*. PhD thesis, Utrecht University, Utrecht.
- Nelson, R. R., & Winter, S. G. (1982). The Schumpeterian tradeoff revisited. *The American Economic Review*, 72(1), 114-132.
- Nooteboom, B. (2000). *Learning and innovation in organizations and economies*. OUP Oxford.
- PerakBizRoute. (2015, September 6). 4 economic corridors to spearhead Perak's development. Retrieved from <http://perakbiz-route.com.my/perak-biz-route-en/general-en/major-government-projects-2/>
- PKNP. (n.d.). Perbadanan Kemajuan Negeri Perak. Retrieved July 26, 2019, from <http://www.pknpgroup.com.my/page/1/Home/>
- Preston, R.E. (1971) The structure of central place systems, *Economic Geography*, 47, pp. 136-155.
- Preston, R.E. (1975) A comparison of five measures of central place importance and of settlement size, *Tijdschrift voor Economische en Sociale Geografie*, 66, pp. 178-187.
- Raspe, O., & Oort, F. V. (2004). ICT loves agglomeration The urban impacts of ICT in the Netherlands.
- Ross, C. (1992) *The Urban System and Networks of Corporate Control*. Greenwich, CT: JAI Press
- RStudio Team (2015). *RStudio: Integrated Development for R*. RStudio, Inc., Boston, MA URL <http://www.rstudio.com/>.

- SSM. (n.d.). Suruhanjaya Syarikat Malaysia (Companies Commission of Malaysia). Retrieved July 26, 2019, from <http://www.ssm.com.my/Pages/Home.aspx>
- Taylor, P. J., Evans, D. M., & Pain, K. (2008). Application of the interlocking network model to mega-city-regions: measuring polycentricity within and beyond city-regions. *Regional Studies*, 42(8), 1079-1093.
- Ullman, E.L. (1941) A theory of location for cities, *American Journal of Sociology*, 46, pp. 853-864.
- Van der Panne, G. (2004). Agglomeration externalities: Marshall versus Jacobs. *Journal of evolutionary economics*, 14(5), 593-604.
- van Grunsven, L. (2019). *Peninsular Malaysia's urban future: gains from polycentricity and polycentric development?*
- Wellman, B. (1997). Structural analysis: From method and metaphor to theory and substance. *Contemporary Studies in Sociology*, 15, 19-61.
- Whitley, R. (1987). Taking firms seriously as economic actors: Towards a sociology of firm behaviour. *Organization Studies*, 8(2), 125-147.
- World Bank Group, Khazanah Nasional, and Economic Planning Unit (2015), *Achieving a System of Competitive Cities*
- WorldPopulationReview (2018). Retrieved from <http://worldpopulationreview.com/>

8. Appendix

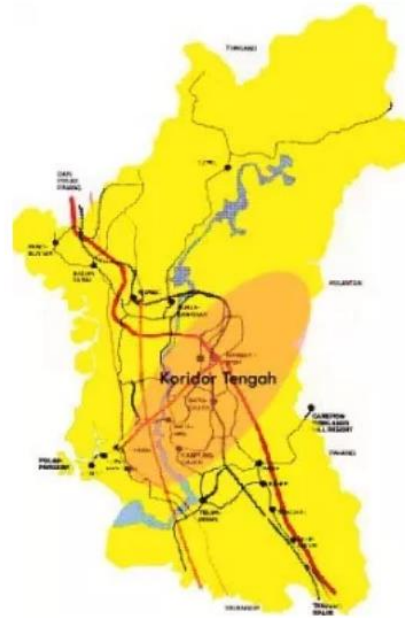
Appendix 1: Economic Corridors (MITH, 2015)

Northern Corridor Economic Region



Northern Corridor Economic Region

Central Perak Economic Corridor



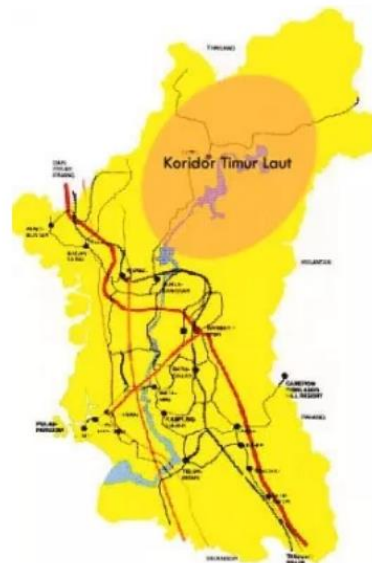
Central Perak Economic Corridor

Southern Perak Economic Corridor



Southern Perak Economic Corridor

Northeastern Perak Economic Corridor



Northeastern Perak Economic Corridor

Appendix 2: GDP share, Industry classification (DOSM, 2016)

PERAK

JADUAL
TABLE 46

KDNK Perak mengikut Jenis Aktiviti Ekonomi, 2010-2016 pada Harga Malar 2010 - RM Juta
GDP for Perak by Kind of Economic Activity, 2010-2016 at Constant 2010 Prices - RM Million

Jenis Aktiviti Ekonomi Kind of Economic Activity
1. Pertanian <i>Agriculture</i>
2. Perlombongan dan Pengkuarian <i>Mining and Quarrying</i>
3. Pembuatan <i>Manufacturing</i>
4. Pembinaan <i>Construction</i>
5. Perkhidmatan <i>Services</i>
5.1 Utiliti, Pengangkutan dan Penyimpanan, Maklumat dan Komunikasi <i>Utilities, Transportation and Storage, Information and Communication</i>
5.2 Perdagangan Borong dan Runcit, Makanan & Minuman dan Penginapan <i>Wholesale and Retail Trade, Food & Beverage and Accommodation</i>
5.3 Kewangan dan Insurans, Hartanah dan Perkhidmatan Pemiagaan <i>Finance and Insurance, Real Estate and Business Services</i>
5.4 Perkhidmatan-perkhidmatan Lain <i>Other Services</i>
5.5 Perkhidmatan Kerajaan <i>Government Services</i>

Appendix 3: Employment distribution, Industry classification (DOSM, 2017)

Industry is classified according to the "Malaysia Standard Industrial Classification (MSIC) 2008". Category of industry are as follows:

A Pertanian, perhutanan dan perikanan <i>Agriculture, forestry and fishing</i>	K Aktiviti kewangan dan insurans/takaful <i>Financial and insurance/takaful activities</i>
B Perlombongan dan pengkuarian <i>Mining and quarrying</i>	L Aktiviti hartanah <i>Real estate activities</i>
C Pembuatan <i>Manufacturing</i>	M Aktiviti profesional, saintifik dan teknikal <i>Professional, scientific and technical activities</i>
D Bekalan elektrik, gas, wap dan pendingin udara <i>Electricity, gas, steam and air conditioning supply</i>	N Aktiviti pentadbiran dan khidmat sokongan <i>Administrative and support service activities</i>
E Bekalan air, pembentungan, pengurusan sisa dan aktiviti pemulihan <i>Water supply; sewerage, waste management and remediation activities</i>	O Pentadbiran awam dan pertahanan; aktiviti keselamatan sosial wajib <i>Public administration and defence; compulsory social security</i>
F Pembinaan <i>Construction</i>	P Pendidikan <i>Education</i>
G Perdagangan borong dan runcit, pembaikan kenderaan bermotor dan motosikal <i>Wholesale and retail trade, repair of motor vehicles and motorcycles</i>	Q Aktiviti kesihatan kemanusiaan dan kerja sosial <i>Human health and social work activities</i>
H Pengangkutan dan penyimpanan <i>Transportation and storage</i>	R Kesenian, hiburan dan rekreasi <i>Arts, entertainment and recreation</i>
I Penginapan dan aktiviti perkhidmatan makanan dan minuman <i>Accommodation and food service activities</i>	S Aktiviti perkhidmatan lain <i>Others service activities</i>
J Maklumat dan komunikasi <i>Information and communication</i>	T Aktiviti isi rumah sebagai majikan <i>Activities of households as employers</i>

Appendix 4: Incorporated Companies, Industry classification (SSM, 2019)

- A. Agriculture, forestry and fishing
- B. Mining and quarrying
- C. Manufacturing
- D. Electricity, gas, steam and air conditioning supply
- E. Construction
- F. Wholesale and retail trade; repair of motor vehicles and motorcycles
- G. Transportation and storage
- H. Accommodation and food service activities
- I. Information and communication
- J. Financial and insurance/takaful activities
- K. Real estate activities
- L. Professional, scientific and technical activities
- M. Administrative and support service activities
- N. Education
- O. Human health and social work activities
- P. Arts, entertainment and recreation
- Q. Other service activities

Appendix 5: Economic specialization, Industry classification (Secondary sources)

Sector
Services
Manufacturing
Administration
Health
Education
E & E
Transport
Retail and Wholesale
Tourism
Recreation
Construction
Agriculture

Appendix 6: Labor force distribution per State, in 2010 and 2016 (% values)

2010:

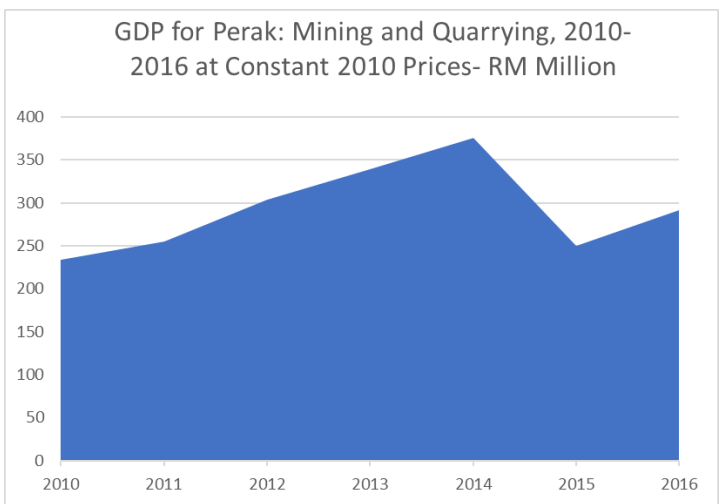
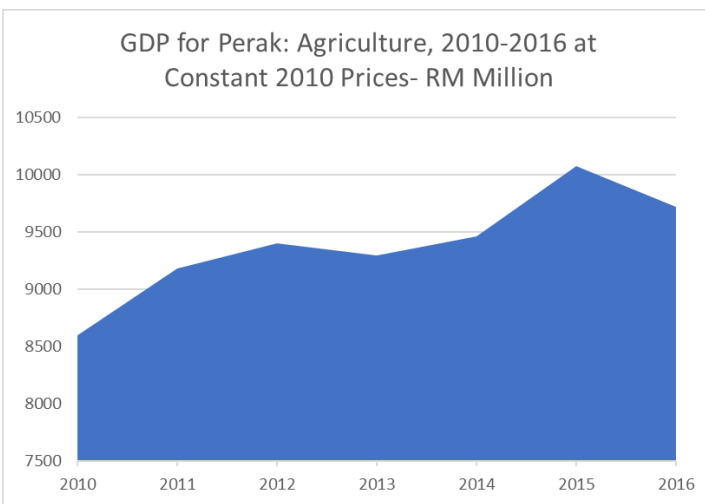
State	A	B	C	D	E	F	G	H	I
Johor	22.78	17.65	14.42	11.29	10.32	7.44	9.66	10.26	10.35
Kedah	7.99	5.88	4.85	2.47	2.83	3.29	2.64	6.35	6.61
Kelantan	8.14	5.88	0.59	1.29	1.55	2.40	1.12	3.82	5.99
Melaka	4.68	0.00	6.26	2.71	2.62	3.08	2.10	4.00	3.30
Negeri Sembilan	6.18	5.88	8.16	3.53	4.57	2.88	2.15	3.88	4.16
Pahang	18.25	23.53	4.96	3.88	2.14	4.64	2.34	10.64	6.41
Pulau Pinang	2.26	0.00	14.89	6.24	7.02	6.41	7.52	8.34	5.73
Perak	15.69	17.65	4.61	5.18	9.44	5.44	4.81	8.36	8.56
Perlis	2.11	0.00	0.24	0.71	0.96	0.32	0.30	0.70	1.37
Selangor	7.09	23.53	33.69	37.29	39.40	28.71	25.22	25.69	16.45
Terengganu	4.83	0.00	5.08	3.41	5.31	1.83	1.02	2.57	5.15
Kuala Lumpur	0.00	5.88	2.13	22.00	13.83	31.74	41.12	15.40	25.93
Average	8.33	8.82	8.32	8.33	8.33	8.18	8.33	8.33	8.33

2016:

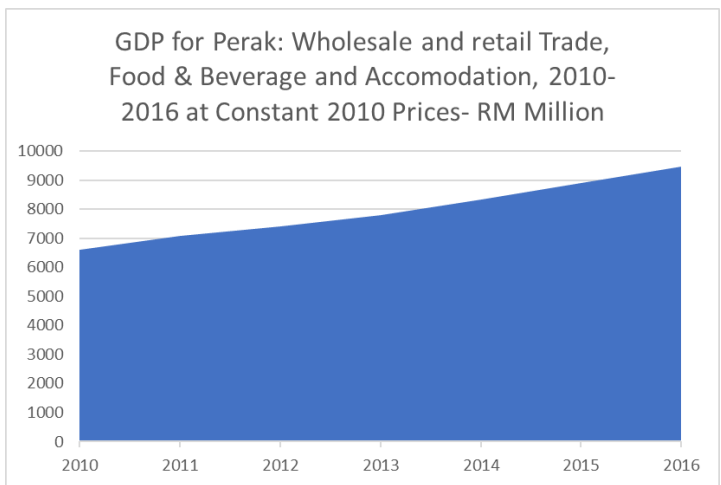
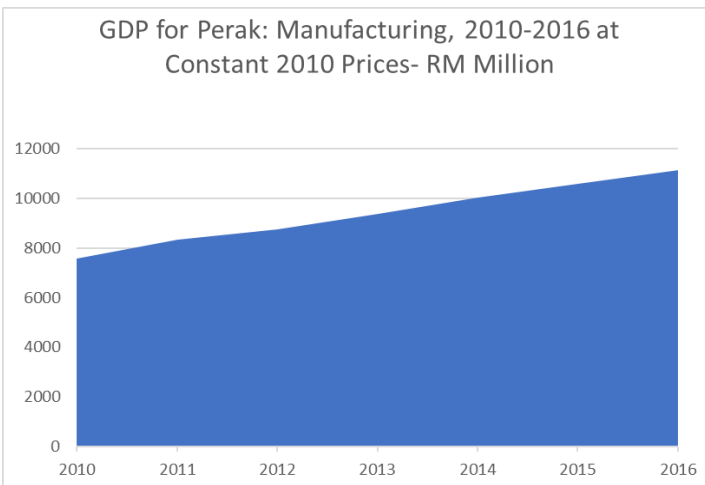
State	A	B	C	D	E	F	G	H	I
Johor	23.22	16.67	14.72	15.80	10.75	7.52	9.35	10.12	10.43
Kedah	8.28	3.33	4.91	1.67	3.09	3.22	2.70	6.00	6.48
Kelantan	8.43	10.00	0.47	1.00	1.60	2.30	1.11	3.68	5.99
Melaka	5.77	3.33	6.19	1.78	2.69	3.01	2.05	4.00	3.33
Negeri Sembilan	6.21	3.33	7.24	2.78	4.33	2.73	2.09	3.66	4.08
Pahang	18.20	26.67	4.79	3.89	2.16	4.34	2.37	11.32	6.28
Pulau Pinang	2.51	3.33	15.07	5.01	7.24	6.37	7.10	8.26	6.20
Perak	16.12	10.00	5.14	5.34	10.02	5.42	4.64	7.88	8.29
Perlis	1.78	0.00	0.23	0.33	0.80	0.31	0.30	0.64	1.42
Selangor	5.77	23.33	33.76	32.26	38.70	29.58	25.89	26.35	16.67
Terengganu	3.99	3.33	5.02	1.78	4.07	1.80	1.04	2.52	4.96
Kuala Lumpur	0.00	3.33	2.57	28.36	14.54	33.39	41.34	15.58	25.86
Average	8.36	8.89	8.34	8.33	8.33	8.33	8.33	8.33	8.33

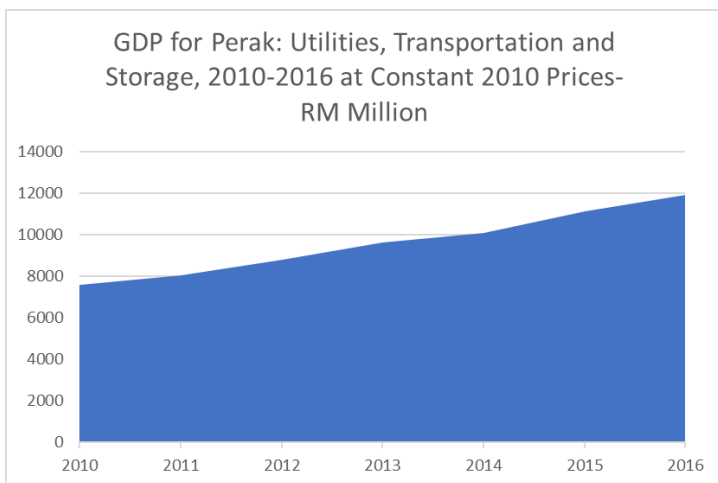
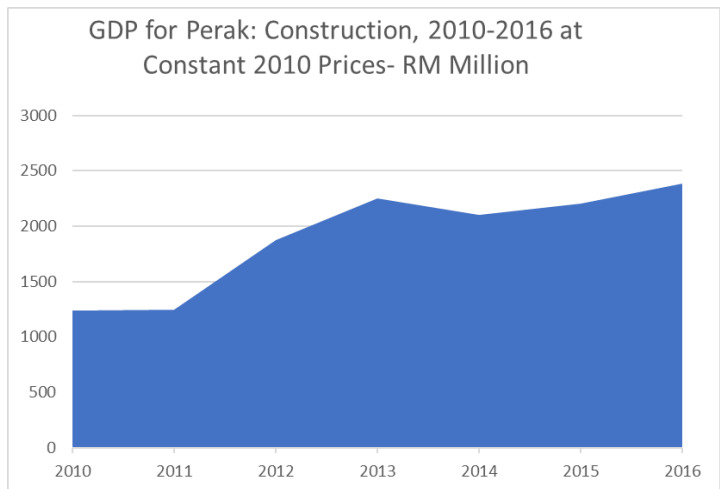
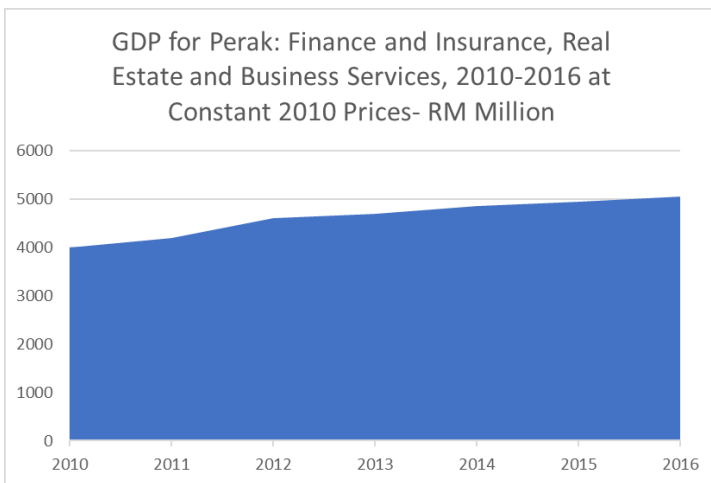
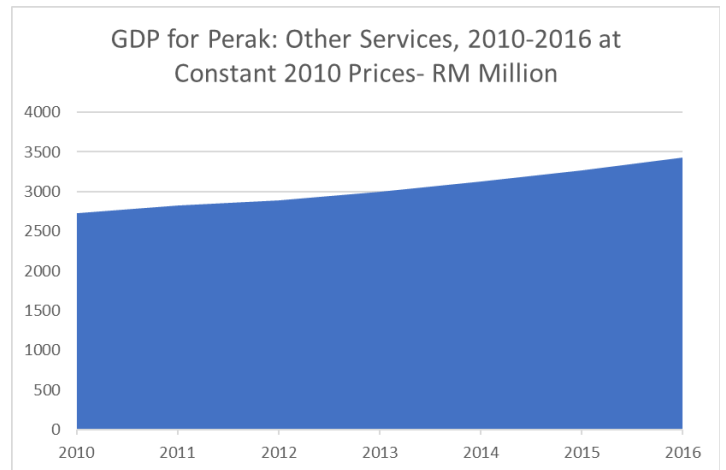
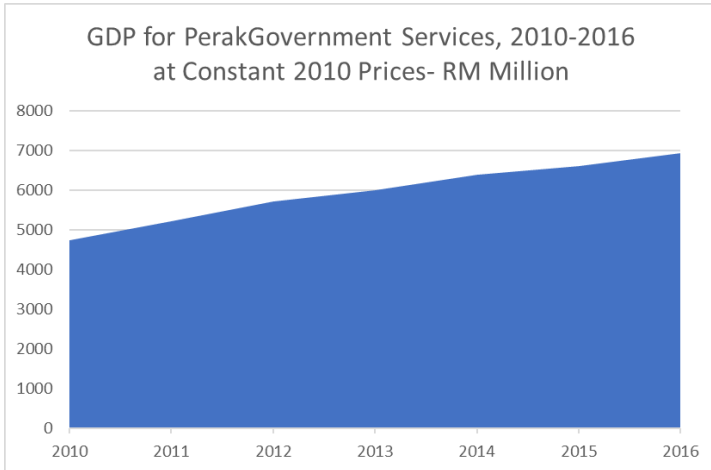
LEGENDA	
Agriculture	A
Mining and Quarrying	B
Manufacturing	C
Construction	D
Utilities, Transportation and Storage, Information and Communication	E
Wholesale and Retail Trade, Food & Beverage and Accommodation	F
Finance and Insurance, Real Estate and Business services	G
Other Services	H
Government Services	I

Appendix 7: GDP growth in Perak per Industry, 2010-2016 (DOSM,



2017)



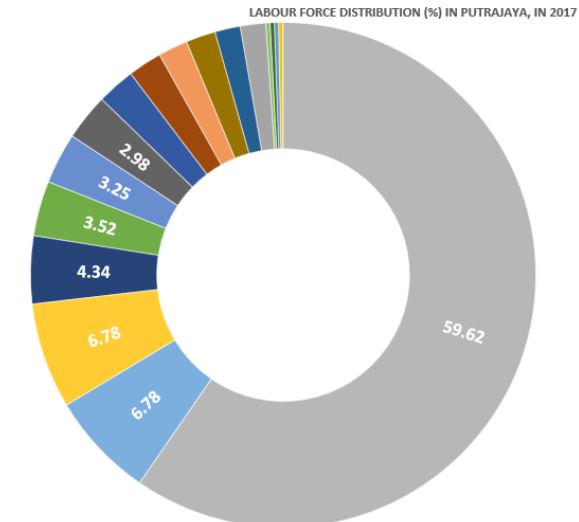
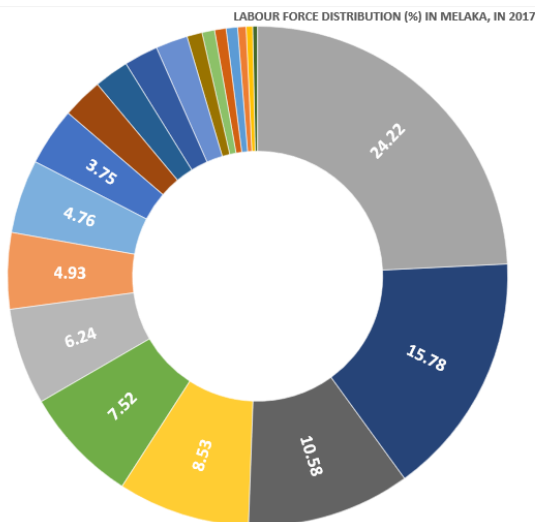
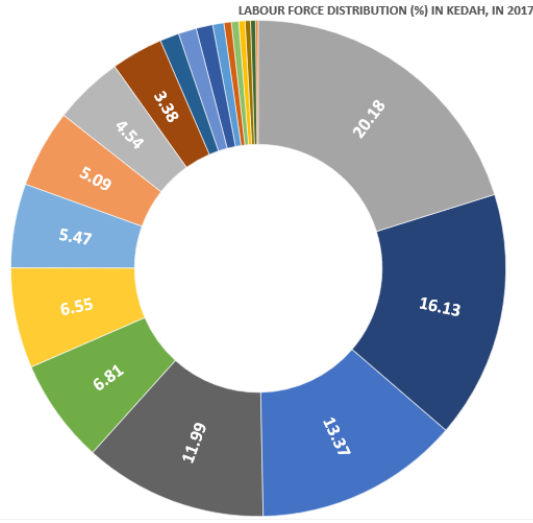
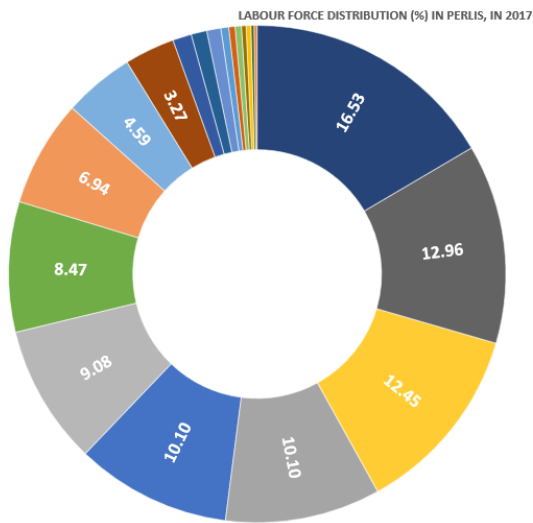


Appendix 8: Labor force per State, divided by Industry, in 2017 (DOSM, 2017)

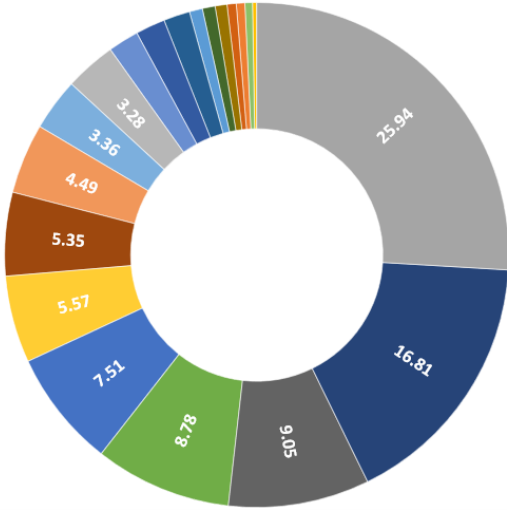
State	A	B	C	D	E	F	G	H	I	J	K	L	M	N	O	P	Q	R	S	T
Putrajaya	0.00	0.00	1.63	0.27	0.27	3.52	4.34	2.17	2.98	1.90	1.63	0.27	3.25	1.90	59.62	6.78	6.78	0.27	0.00	2.44
Kuala Lum	0.05	0.00	5.72	0.30	1.07	9.90	22.10	5.09	10.34	4.39	6.95	1.98	7.61	5.78	5.69	4.37	3.99	0.90	2.81	0.90
Perlis	10.10	0.20	10.10	0.31	0.51	8.47	16.53	3.27	12.96	0.31	1.02	0.20	0.92	6.94	9.08	12.45	4.59	0.41	1.22	0.41
Penang	1.24	0.05	36.39	0.23	0.78	5.89	16.42	4.93	8.40	0.90	1.89	0.68	2.60	3.55	3.94	4.90	3.76	0.67	2.04	0.74
Melaka	3.75	0.54	24.22	0.42	0.74	7.52	15.78	2.61	10.58	0.99	2.24	0.32	2.07	4.93	6.24	8.53	4.76	0.81	2.19	0.74
Negeri Ser	7.91	0.34	18.42	0.65	0.55	8.24	13.87	5.75	9.88	0.88	2.79	0.55	2.10	5.43	6.57	7.49	5.35	0.69	1.30	1.26
Terenggan	9.20	3.03	11.52	0.94	0.69	12.27	17.41	3.01	10.76	0.37	0.99	0.16	1.24	5.99	7.13	8.21	4.59	0.62	1.67	0.21
Selangor	1.64	0.81	20.35	0.37	0.35	9.17	16.68	6.14	7.95	3.67	4.78	0.91	3.92	5.48	4.15	5.51	4.43	0.66	2.11	0.89
Kelantan	14.81	0.22	9.63	0.42	0.21	12.03	21.94	2.52	10.91	0.45	1.21	0.09	0.93	4.22	5.91	7.70	4.87	0.34	1.25	0.33
Perak	10.49	0.48	16.84	0.67	0.63	6.97	18.17	3.38	12.11	0.44	1.74	0.10	1.33	4.80	6.13	7.09	5.25	0.60	1.92	0.84
Kedah	13.37	0.18	20.18	0.41	0.73	6.81	16.13	3.38	11.99	0.35	1.25	0.33	1.18	5.09	4.54	6.55	5.47	0.48	1.08	0.49
Johor	7.51	0.55	25.94	0.27	0.84	8.78	16.81	5.35	9.05	0.76	1.69	0.82	1.97	4.49	3.28	5.57	3.36	0.48	1.90	0.59
Pahang	21.19	0.75	11.62	0.32	0.73	7.40	16.33	3.93	8.76	0.55	1.17	0.20	0.84	4.77	6.44	7.93	5.02	0.54	1.26	0.26
National a	7.79	0.55	16.35	0.43	0.62	8.23	16.35	3.96	9.74	1.23	2.26	0.51	2.30	4.88	9.90	7.16	4.78	0.58	1.60	0.78

LEGENDA	
Agriculture, forestry and fishing	A
Mining and quarrying	B
Manufacturing	C
Electricity, gas, steam and air conditioning supply	D
Water supply; sewerage, waste management and remediation activities	E
Construction	F
Wholesale and retail trade, repair of motor vehicles and motorcycles	G
Transportation and storage	H
Accommodation and food service activities	I
Information and communication	J
Financial and insurance/takaful activities	K
Real estate activities	L
Professional, scientific and technical activities	M
Administrative and support service activities	N
Public administration and defence; compulsory social security	O
Education	P
Human health and social work activities	Q
Arts, entertainment and recreation	R
Others service activities	S
Activities of households as employers	T

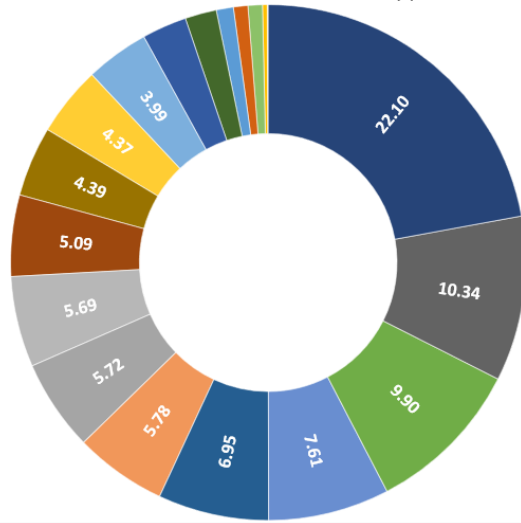
Appendix 9: Labor force distribution per State in 2017 (DOSM, 2018)



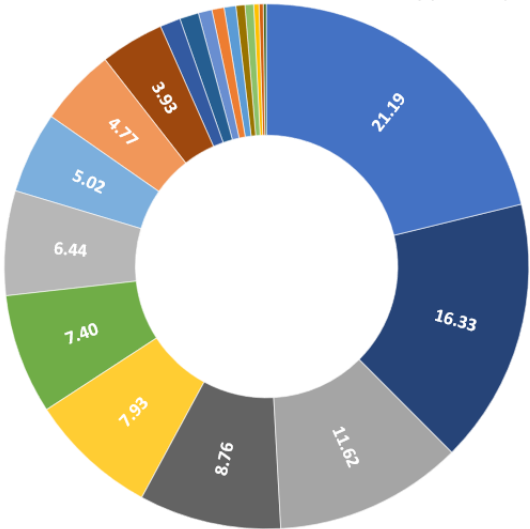
LABOUR FORCE DISTRIBUTION (%) IN JOHOR, IN 2017



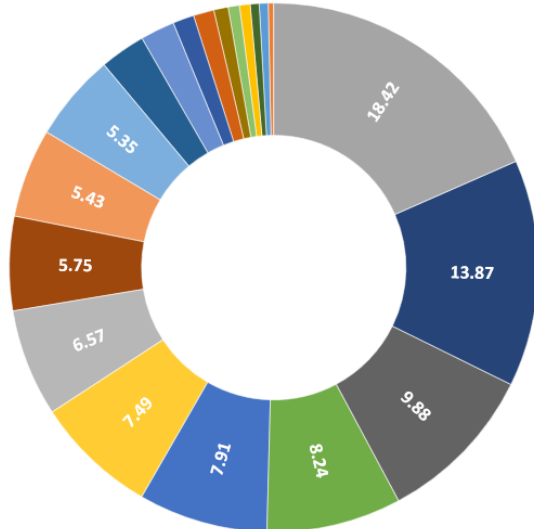
LABOUR FORCE DISTRIBUTION (%) IN KUALA LUMPUR, IN 2017



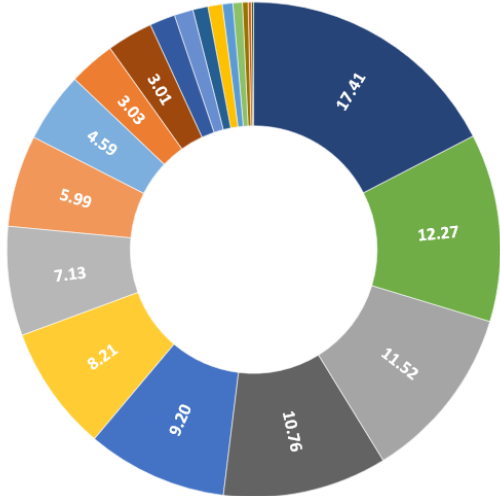
LABOUR FORCE DISTRIBUTION (%) IN PAHANG, IN 2017



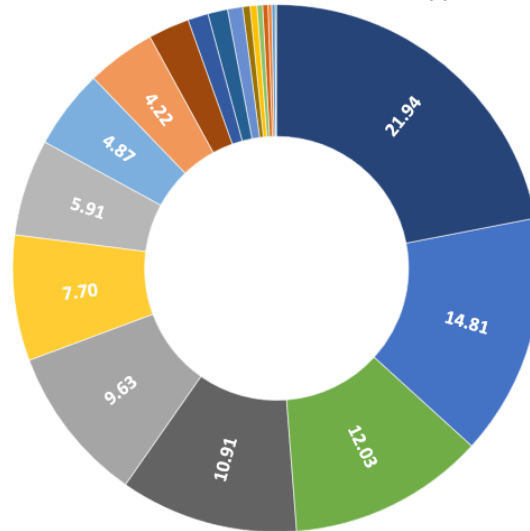
LABOUR FORCE DISTRIBUTION (%) IN NEGERI SEMBILAN, IN 2017



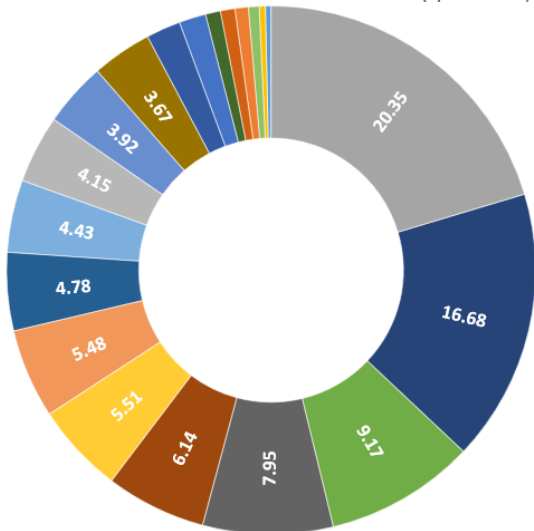
LABOUR FORCE DISTRIBUTION (%) IN TERENGGANU, IN 2017



LABOUR FORCE DISTRIBUTION (%) IN KELANTAN, IN 2017

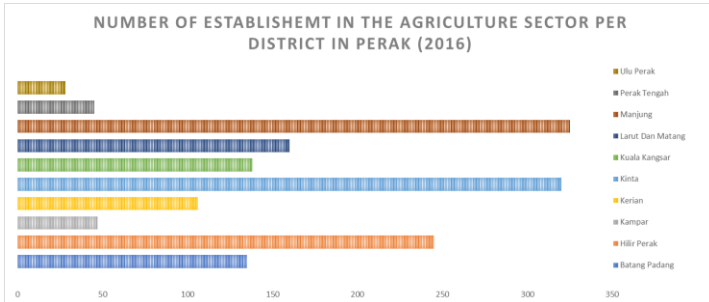
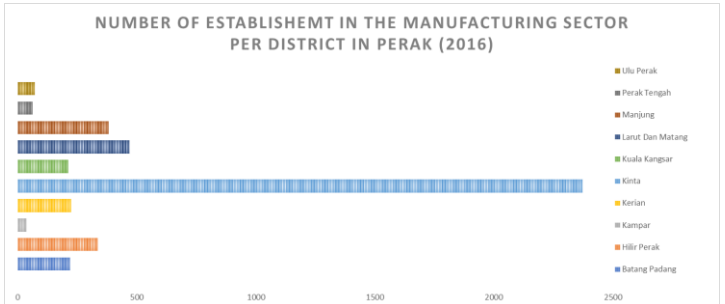
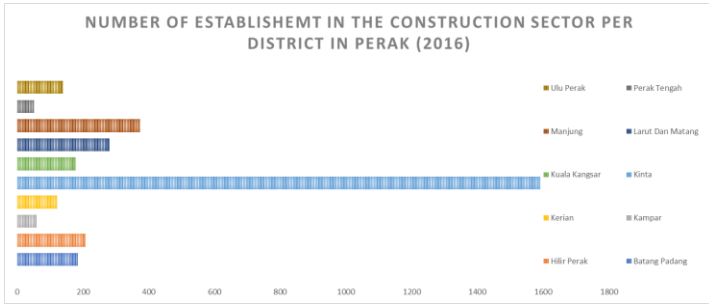
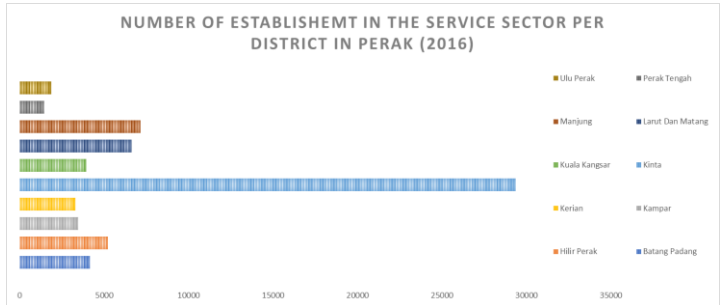
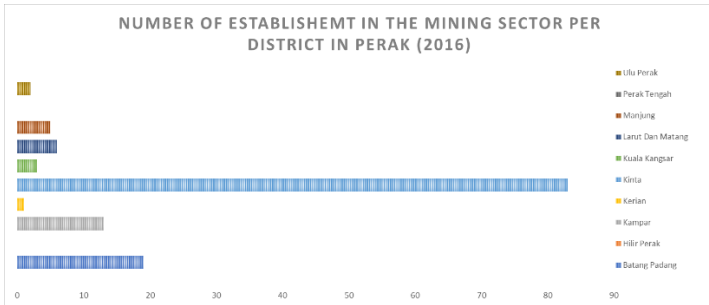


LABOUR FORCE DISTRIBUTION (%) IN SELANGOR, IN 2017



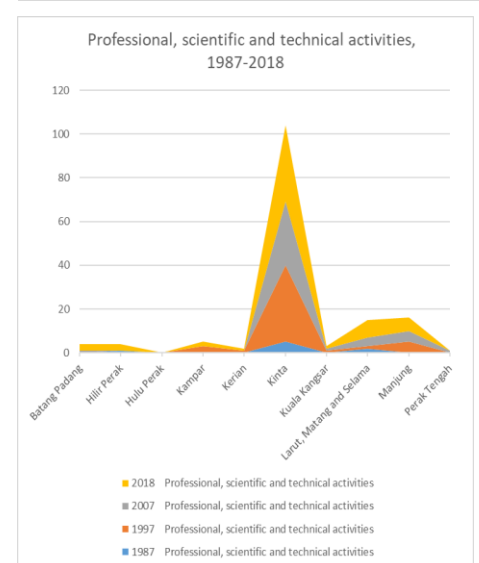
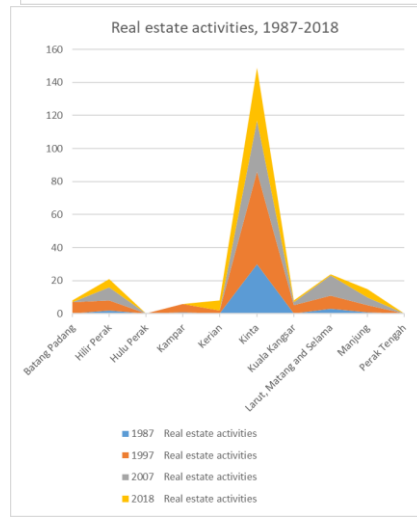
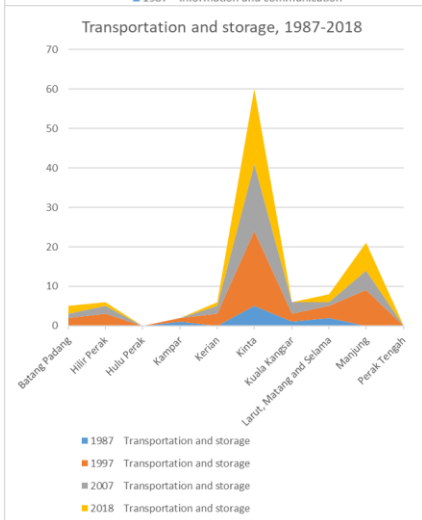
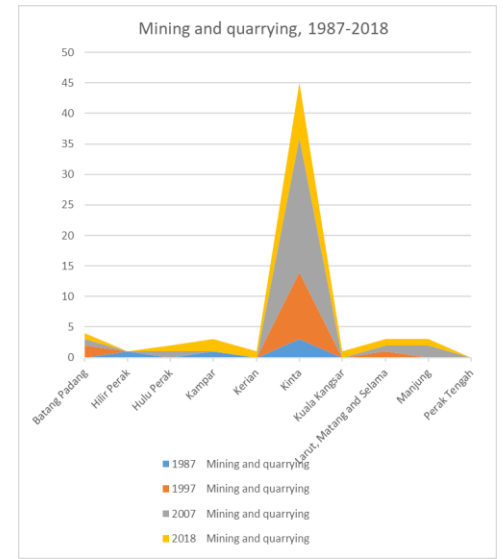
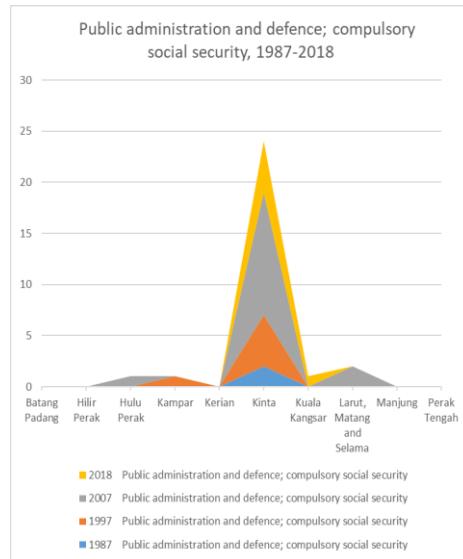
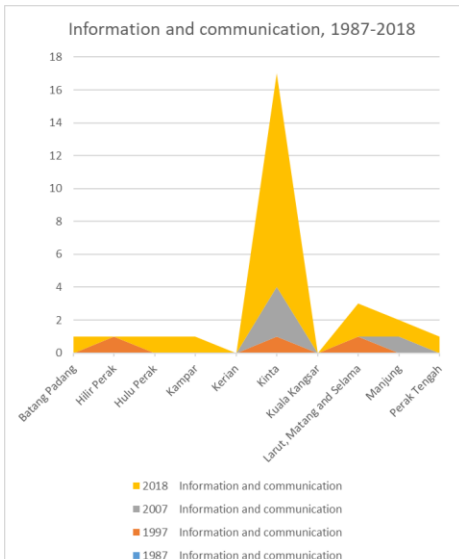
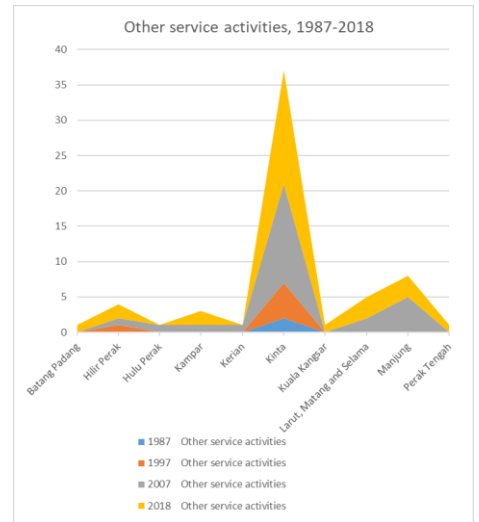
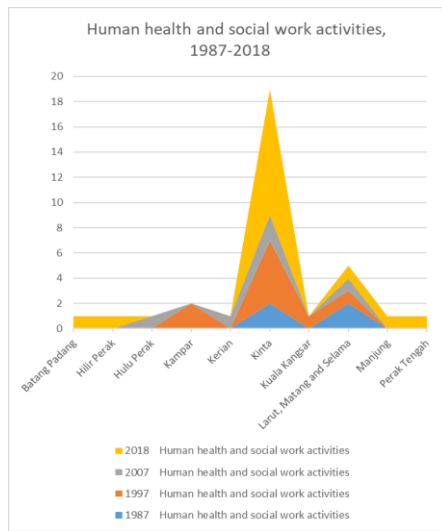
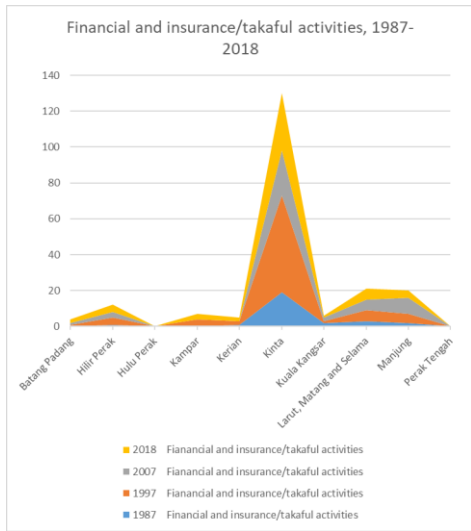
- Agriculture, forestry and fishing
- Mining and quarrying
- Manufacturing
- Electricity, gas, steam and air conditioning supply
- Water supply; sewerage, waste management and remediation activities
- Construction
- Wholesale and retail trade, repair of motor vehicles and motorcycles
- Transportation and storage
- Accommodation and food service activities
- Information and communication
- Financial and insurance/takaful activities
- Real estate activities
- Professional, scientific and technical activities
- Administrative and support service activities
- Public administration and defence; compulsory social security
- Education
- Human health and social work activities
- Arts, entertainment and recreation
- Others service activities
- Activities of households as employers

Appendix 10: Number of Establishment per district in 2016 (DOSM)



Appendix 11: Growth in number of Incorporated Companies per district, 1987-2018



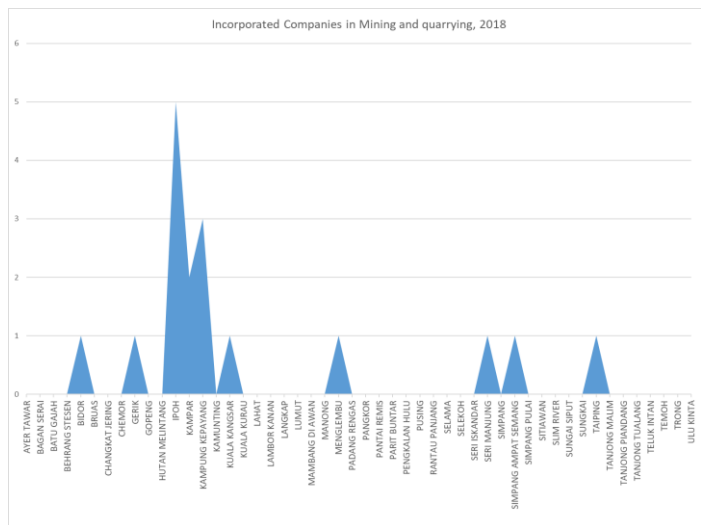
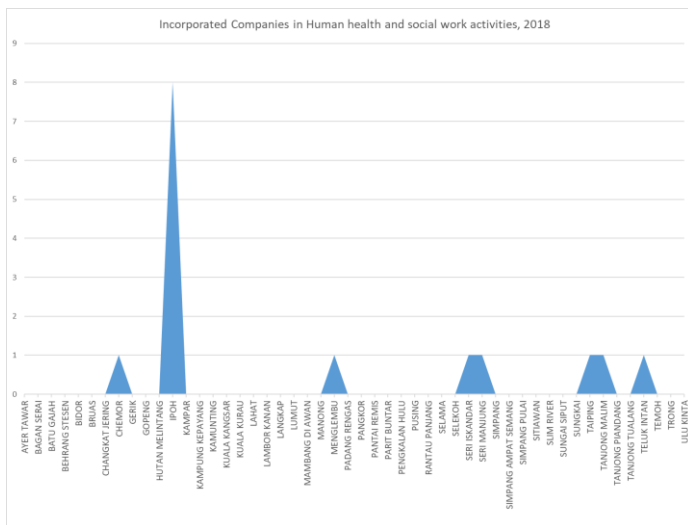
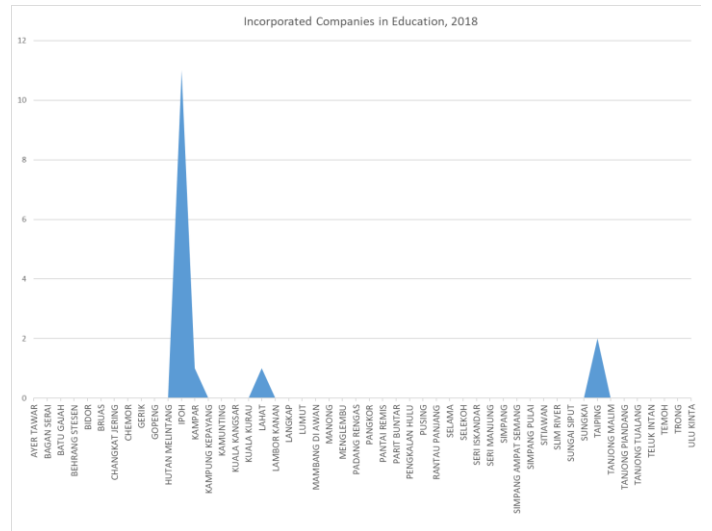
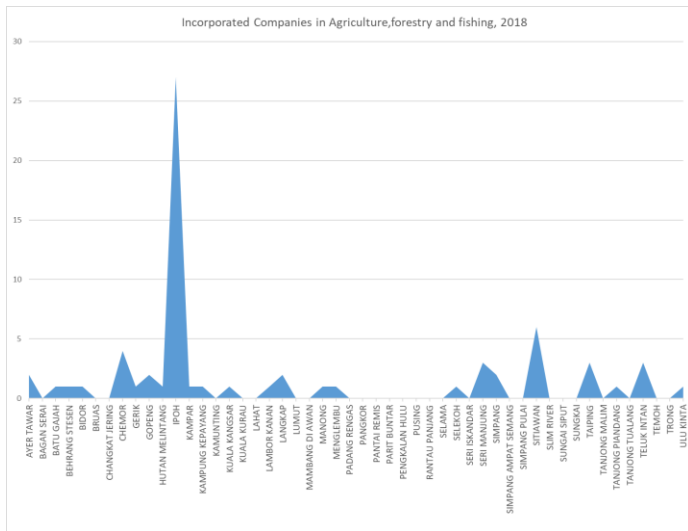


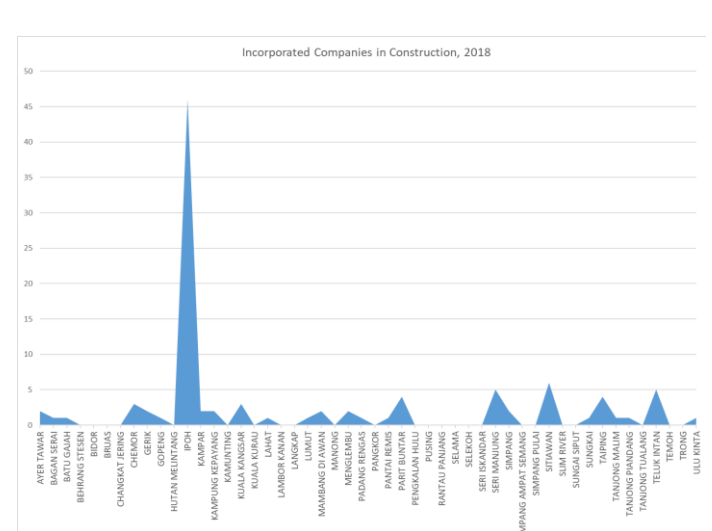
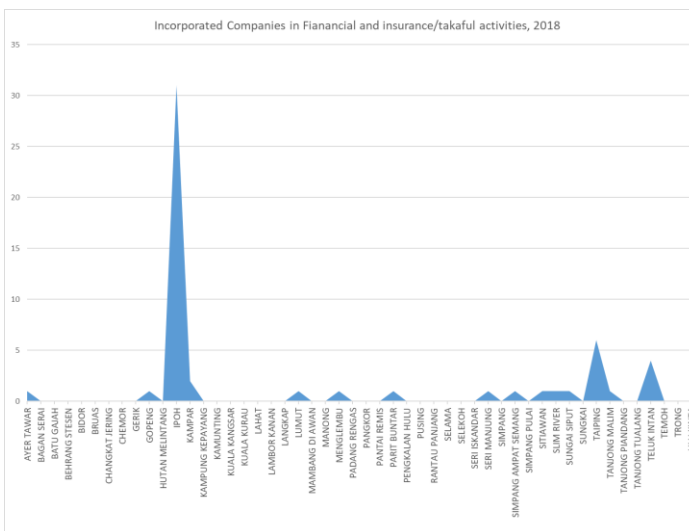
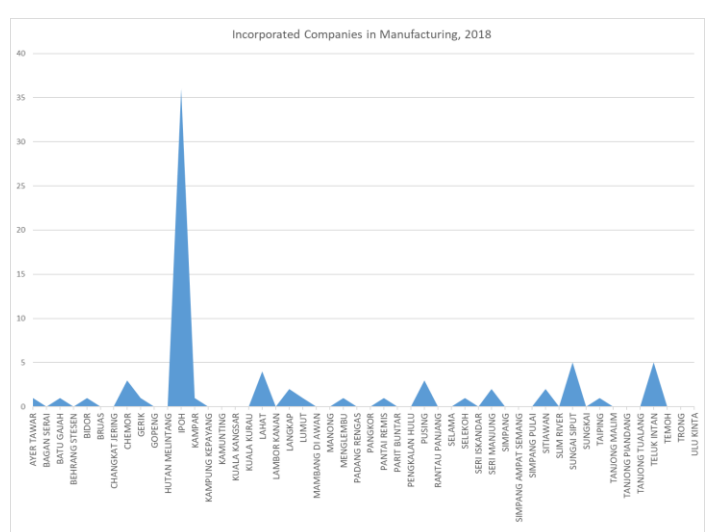
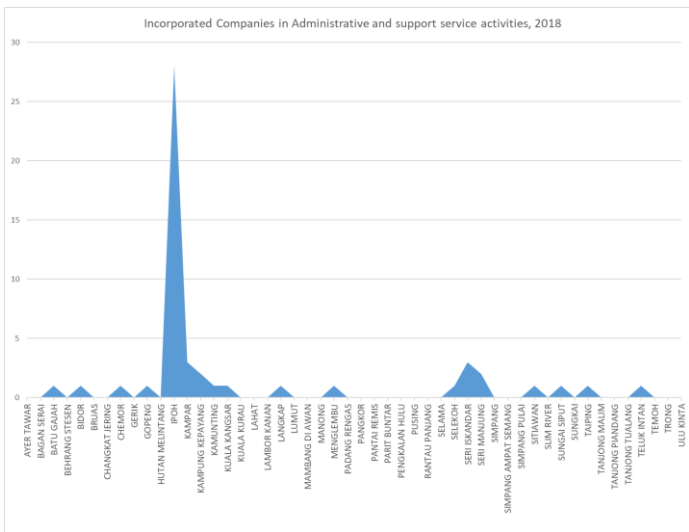
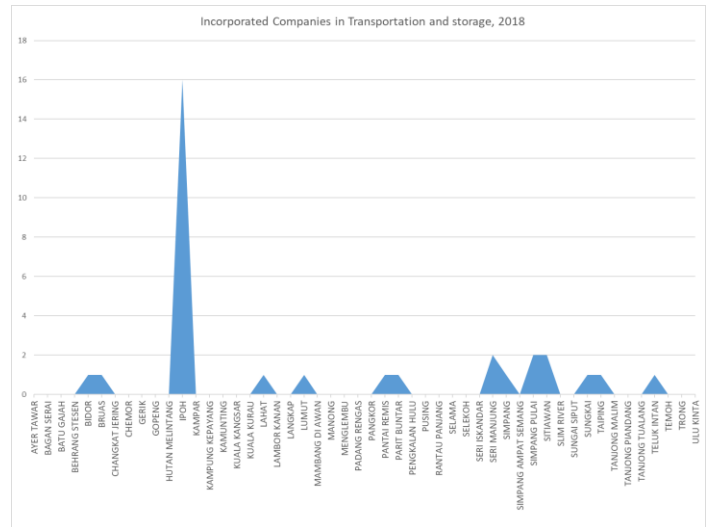
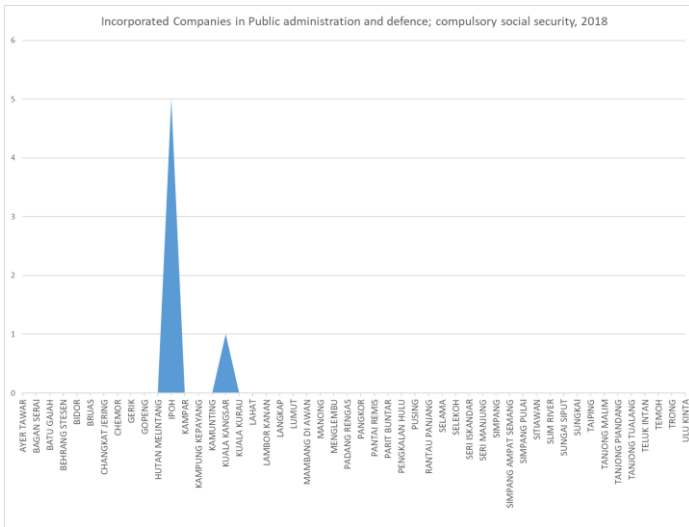
Appendix 12: Economic sectors' Relatedness to cities in the Perak Diamond

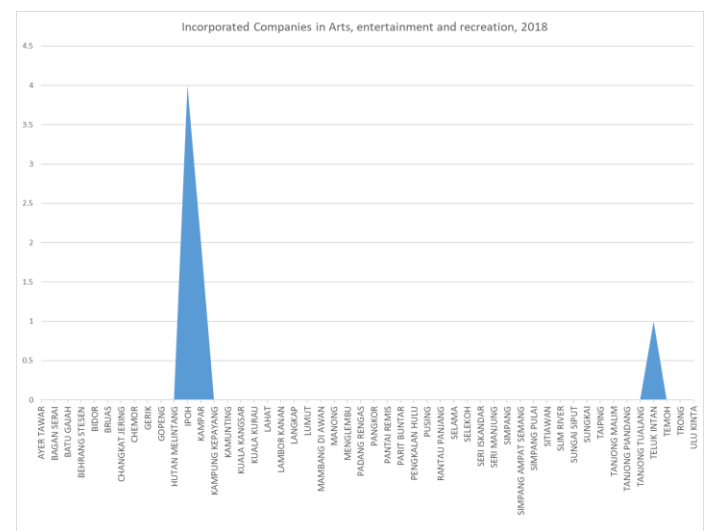
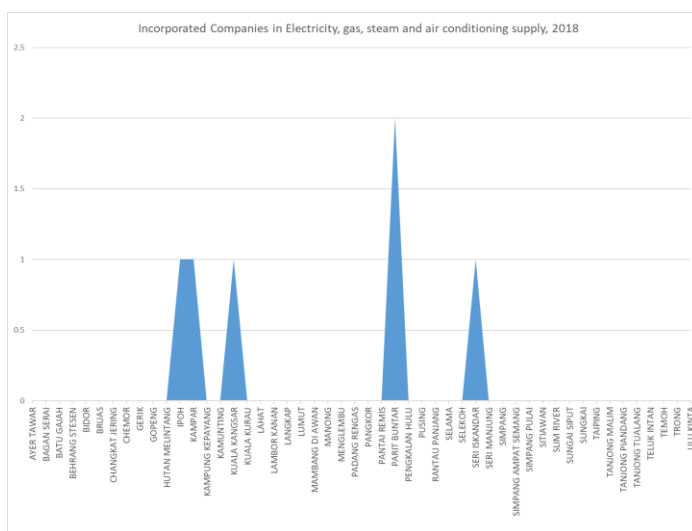
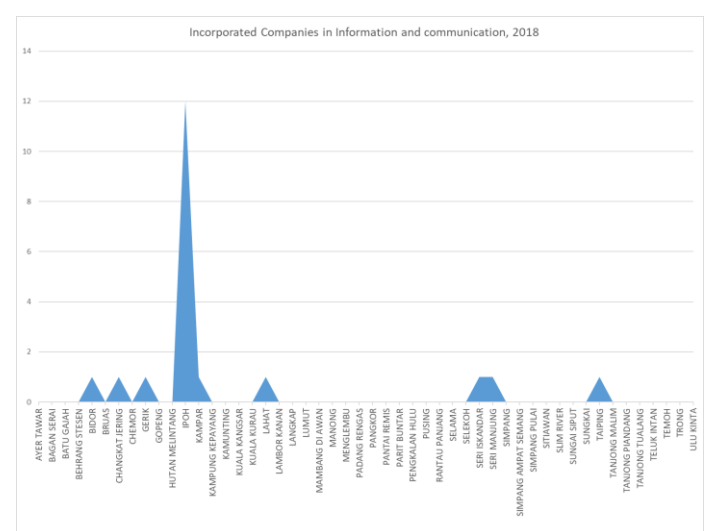
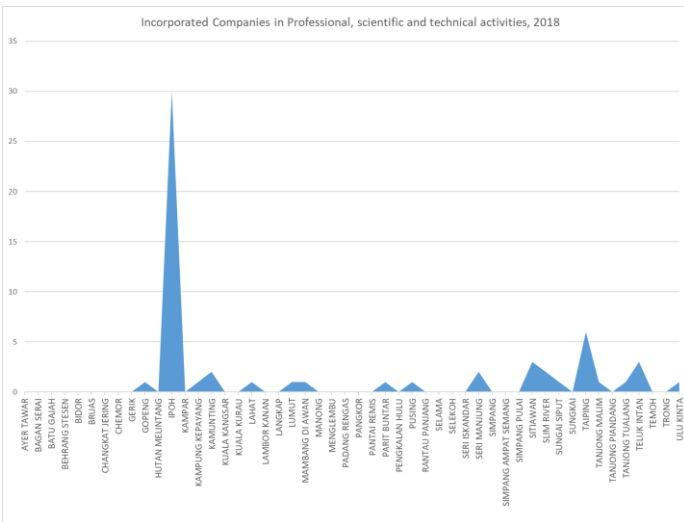
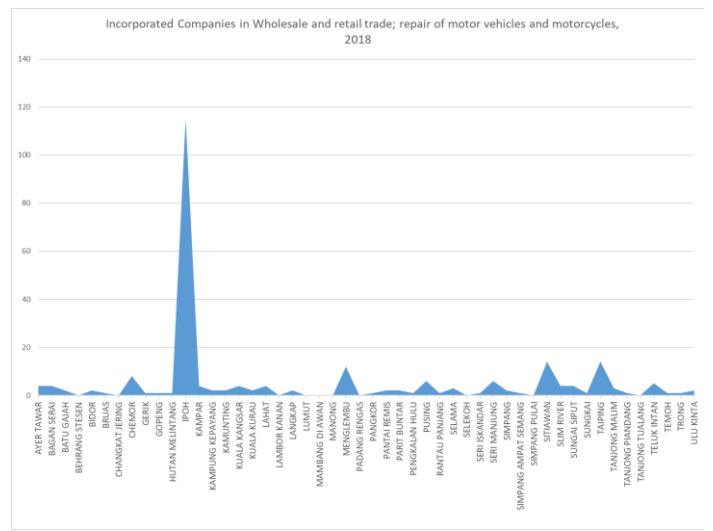
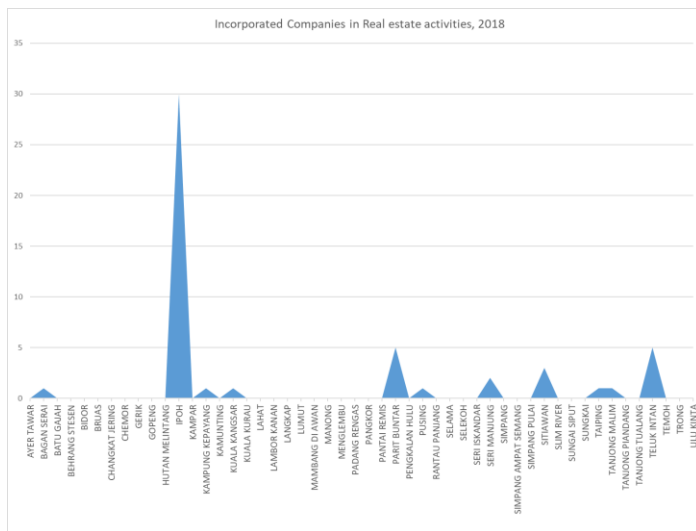
City	Services	Manufacturing	Administration	Health	Education	Electronics	Transport	Retail and wholesale	Tourism	Recreation	Construction	Agriculture	Average RD
Ipoh	60	57.14	25	100	40	100	50	50	25	50	50	57.14	55.36
Kampar	0	14.29	0	0	0	0	0	16.67	0	16.67	16.67	14.29	6.55
Kerian	40	14.29	50	0	20	0	16.67	0	25	16.67	16.67	14.29	17.80
Kuala Kangsar	60	28.57	25	75	40	75	16.67	16.67	25	50	50	57.14	43.25
Lenggong-Gerik	60	14.29	75	0	20	0	33.33	0	75	50	16.67	42.86	32.26
Lumut-Sitiawan	40	42.86	25	50	60	50	50	33.33	25	16.67	50	42.86	40.48
Seri Iskandar	20	42.86	25	0	40	0	33.33	33.33	25	33.33	33.33	28.57	26.23
Taping	60	42.86	75	25	60	25	33.33	50	75	100	50	71.43	55.64
Tanjung Malir	0	42.86	0	50	60	50	33.33	50	0	50	50	42.86	35.75
Tapah	20	28.57	25	25	20	25	33.33	16.67	25	33.33	16.67	42.86	25.95
Teluk Intan	40	14.29	50	0	20	0	33.33	0	75	33.33	16.67	28.57	25.93

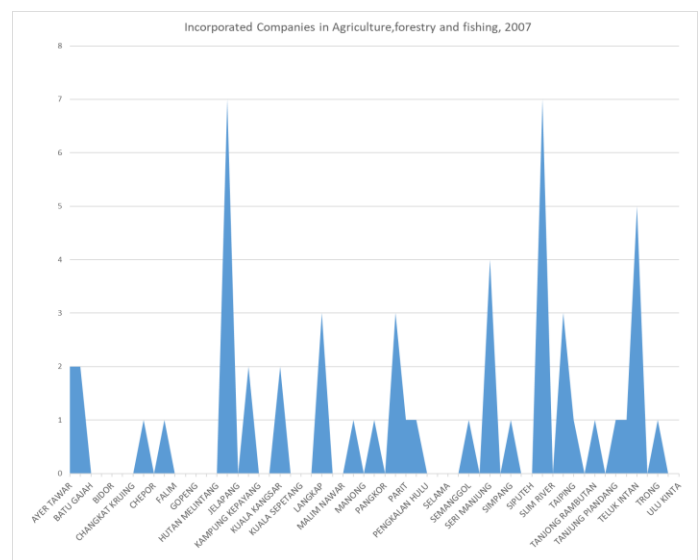
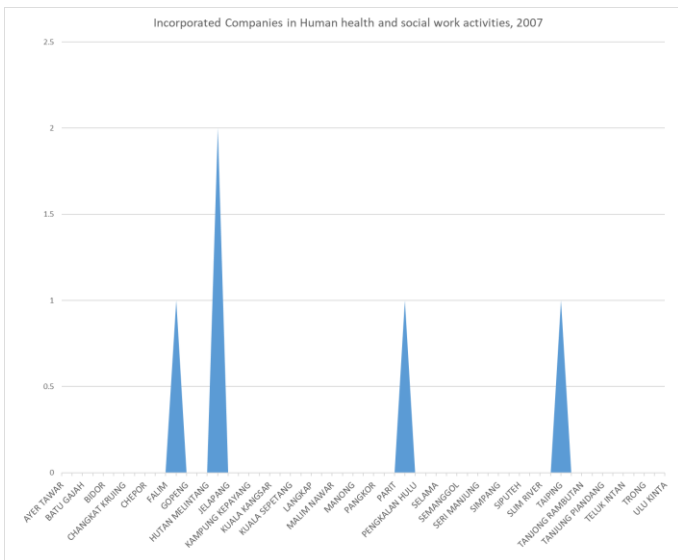
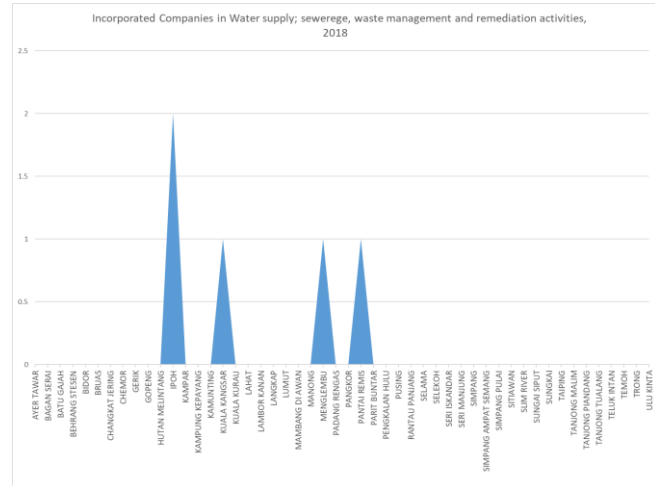
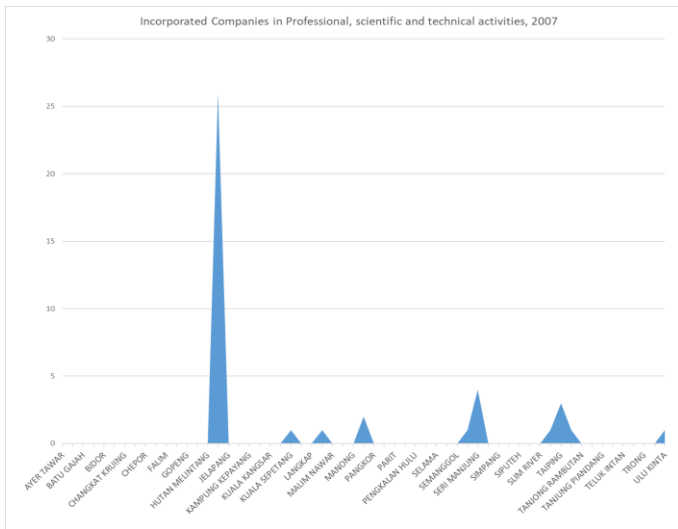
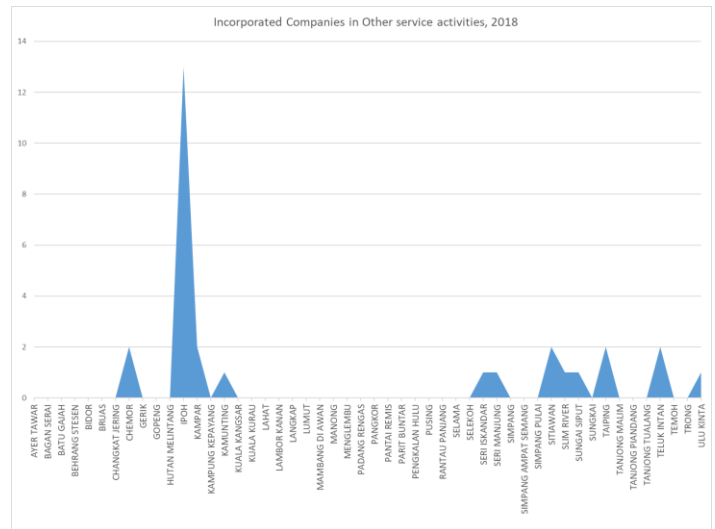
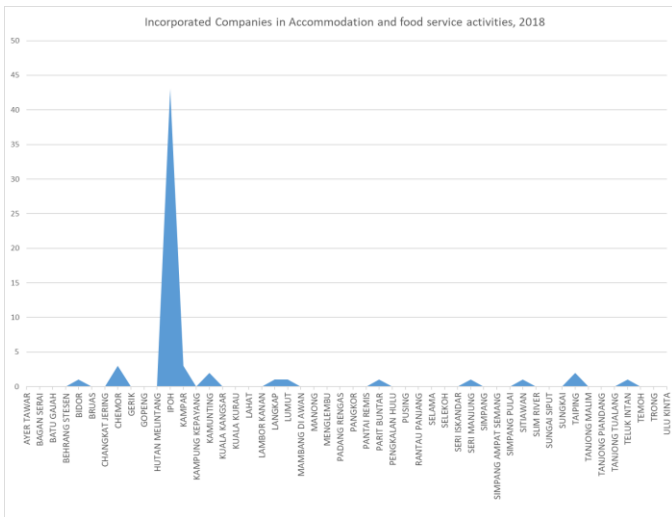
LEGENDA
 CITY IS RELATED TO SECTOR WHICH IS NOT PRESENT IN ITS INDUSTRY PORTFOLIO (RD>AVERAGE)

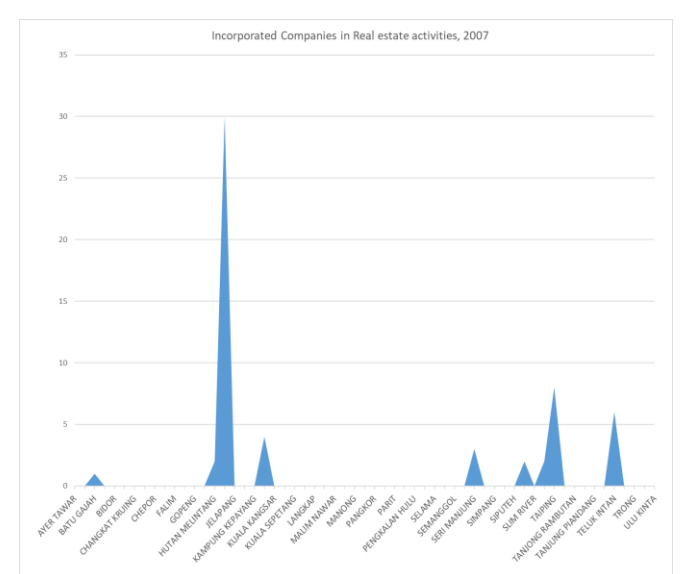
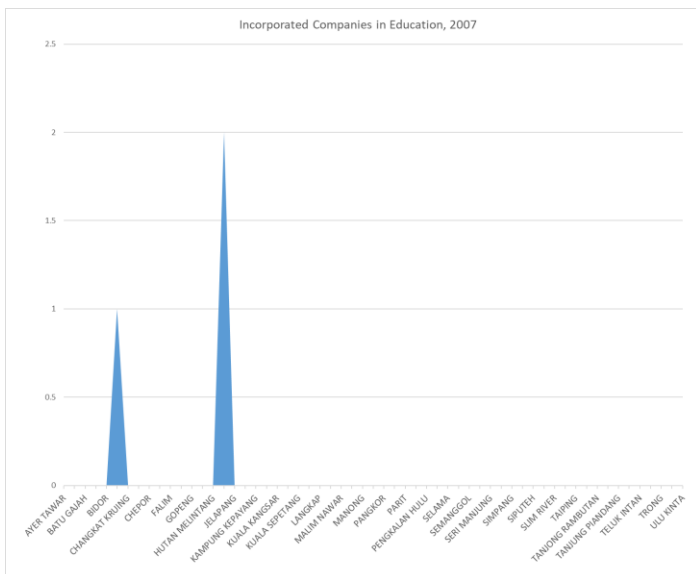
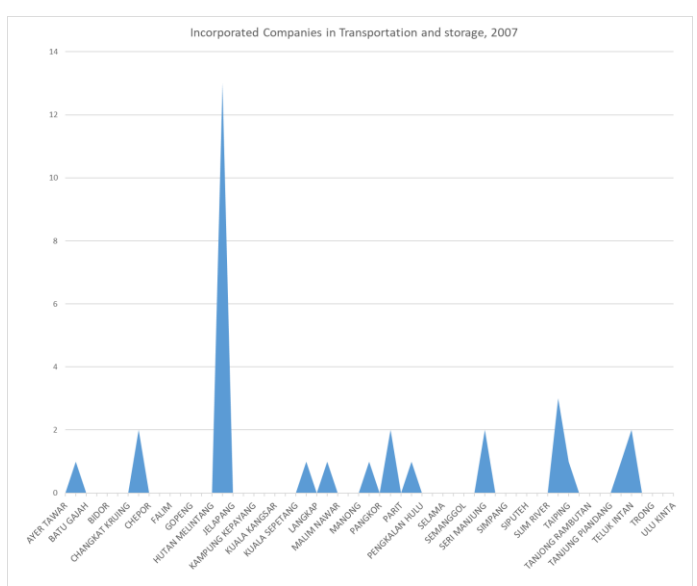
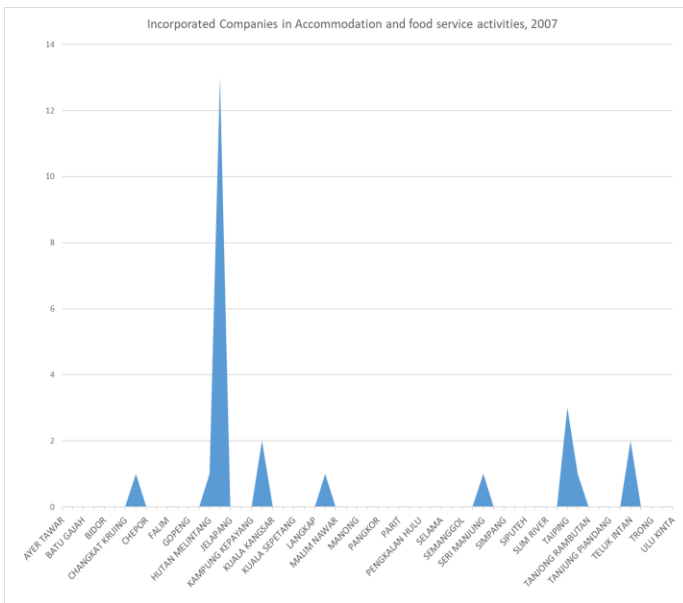
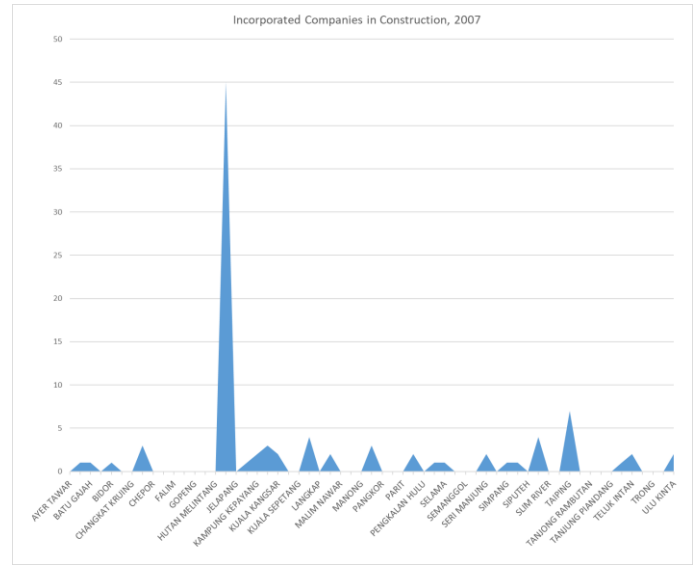
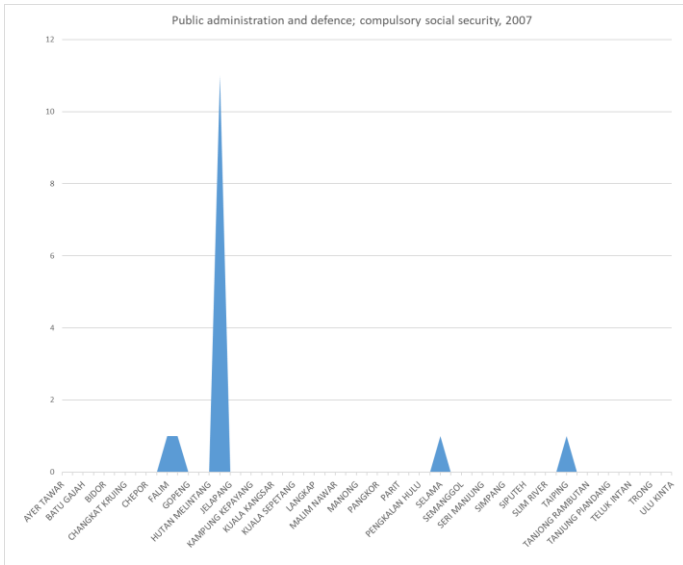
Appendix 13: Incorporated Companies per city, 1987-2018 (SSM, 2019)

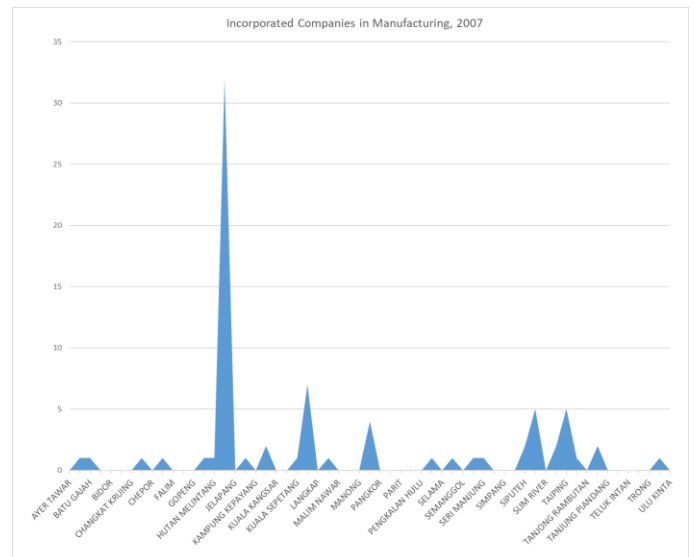
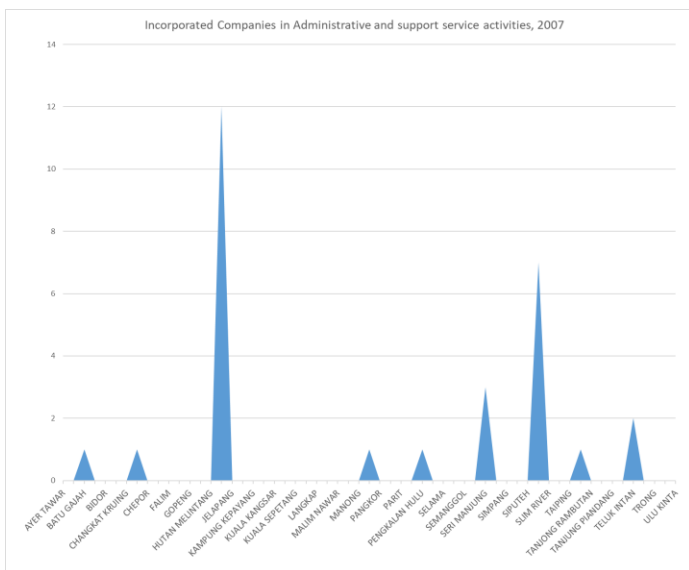
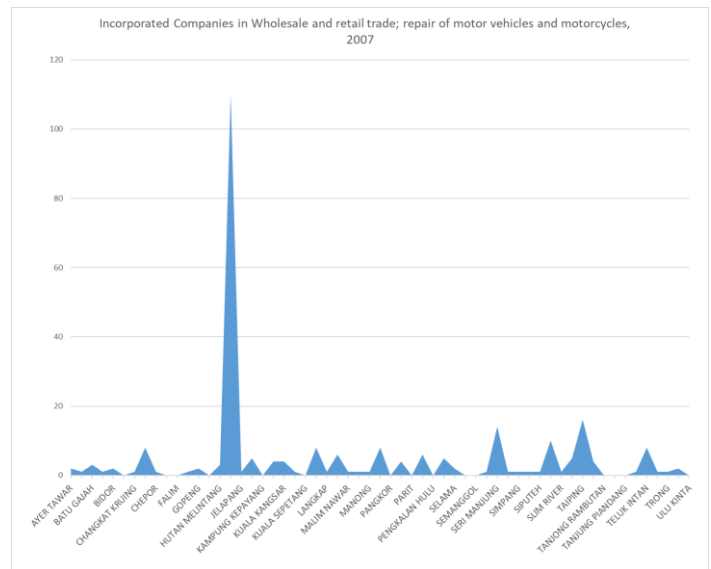
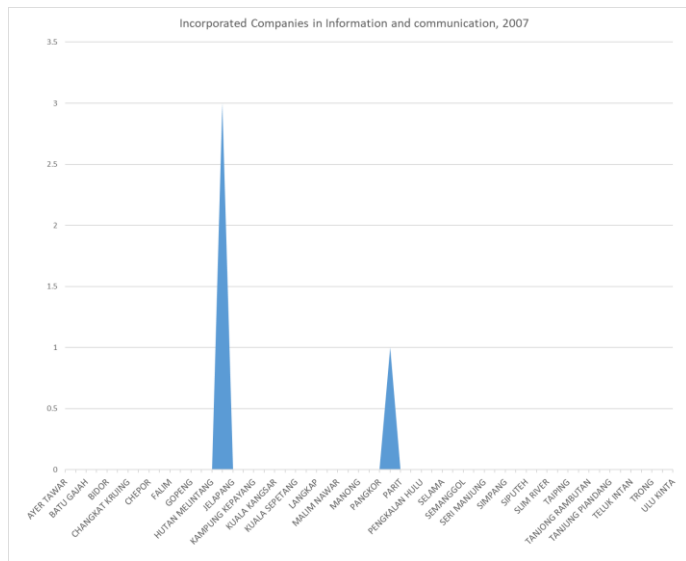
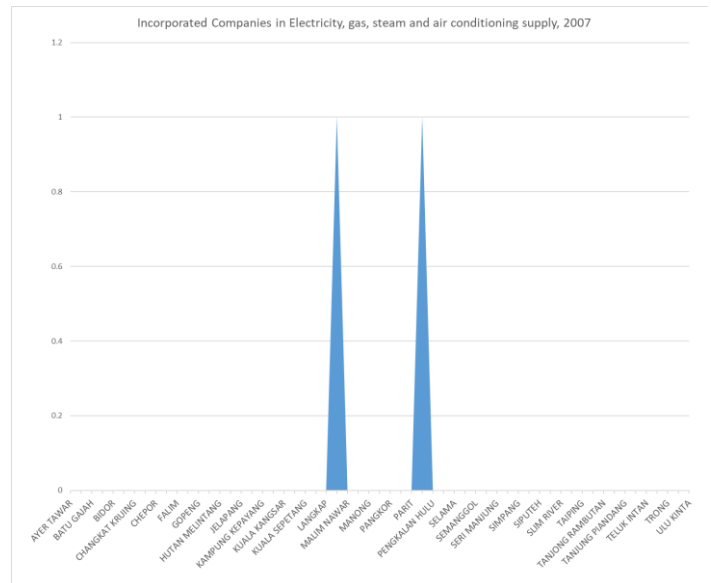
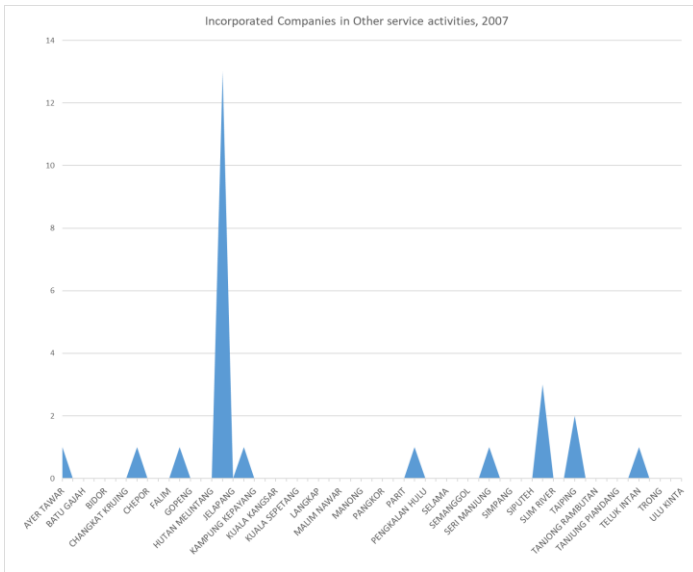


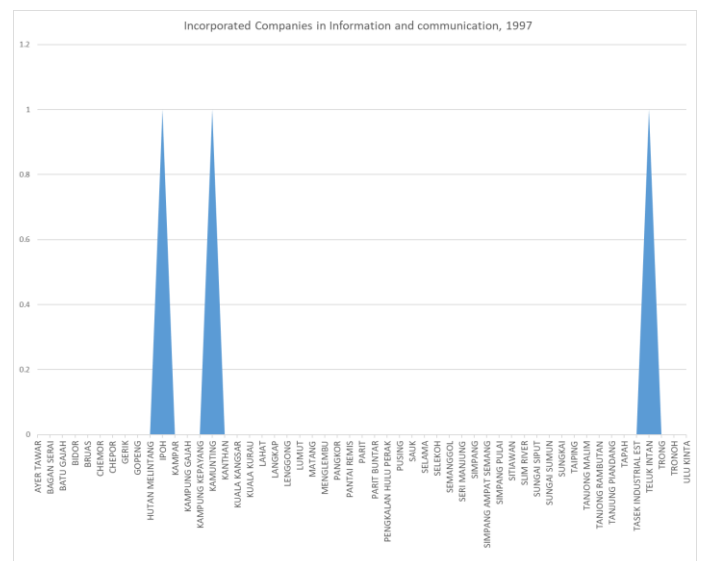
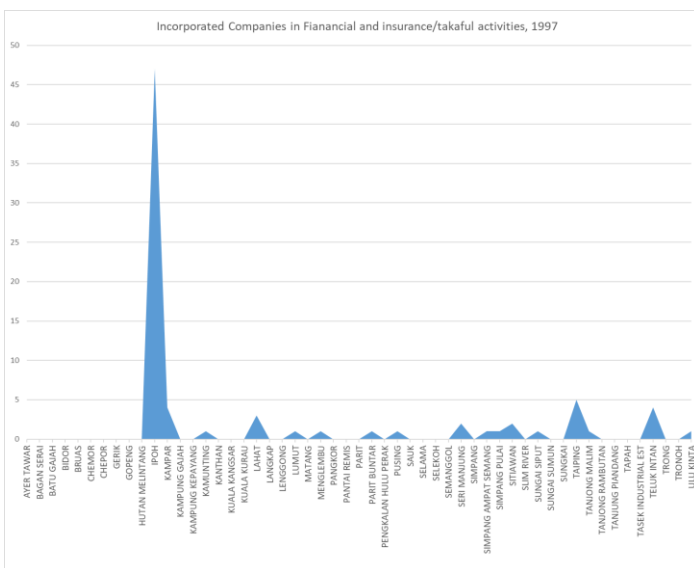
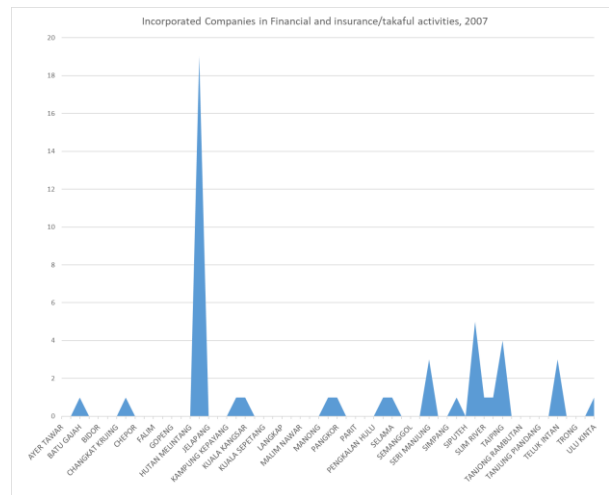
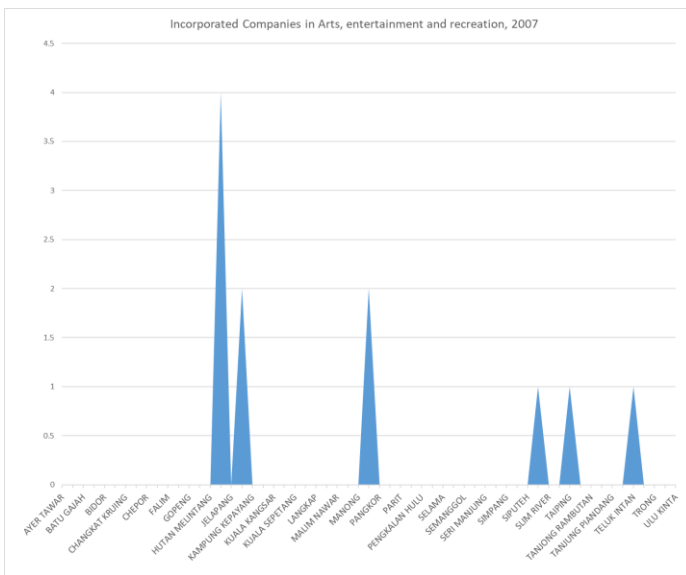
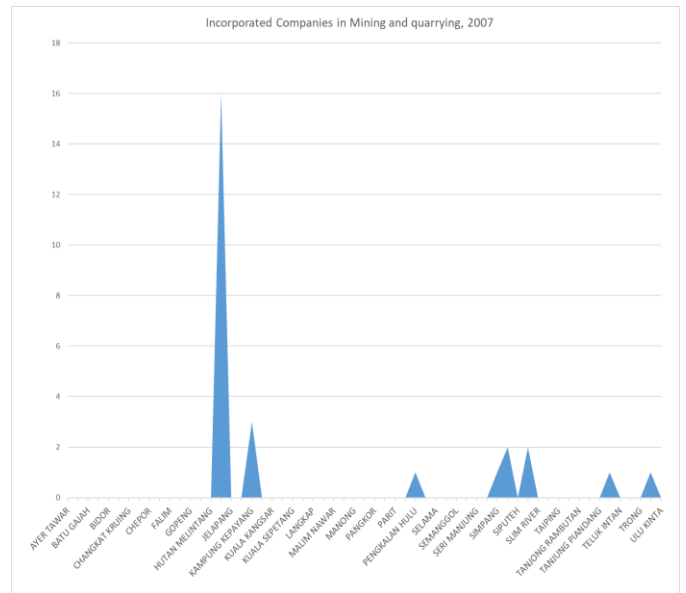
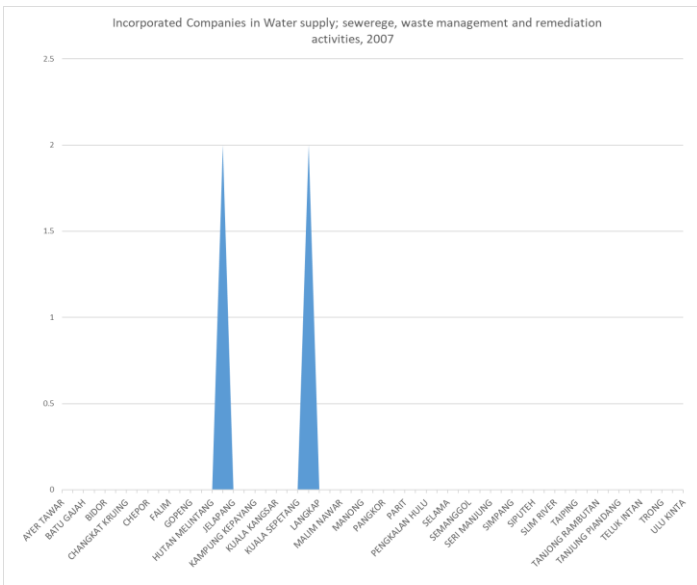


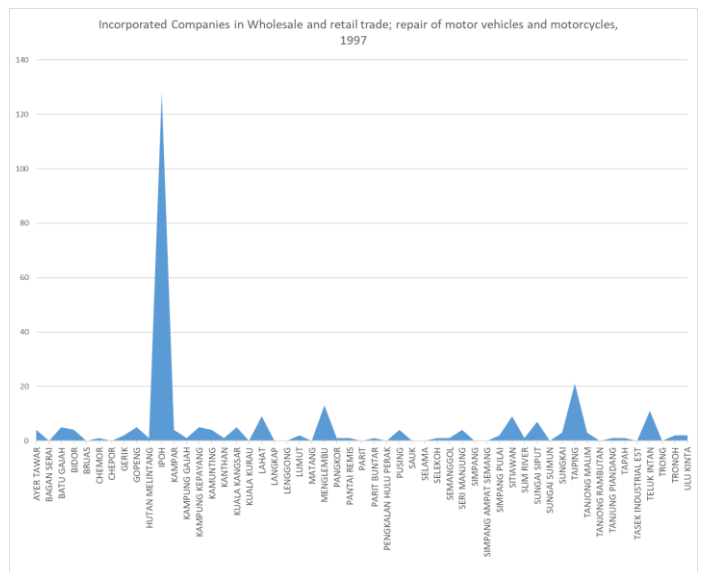
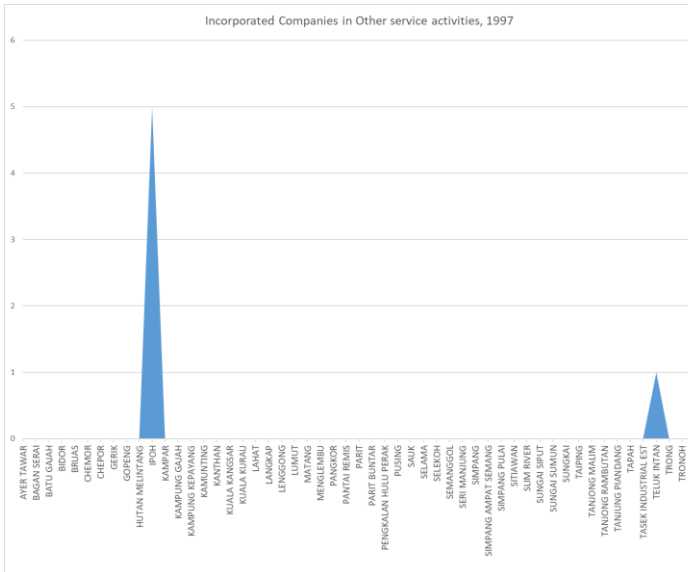
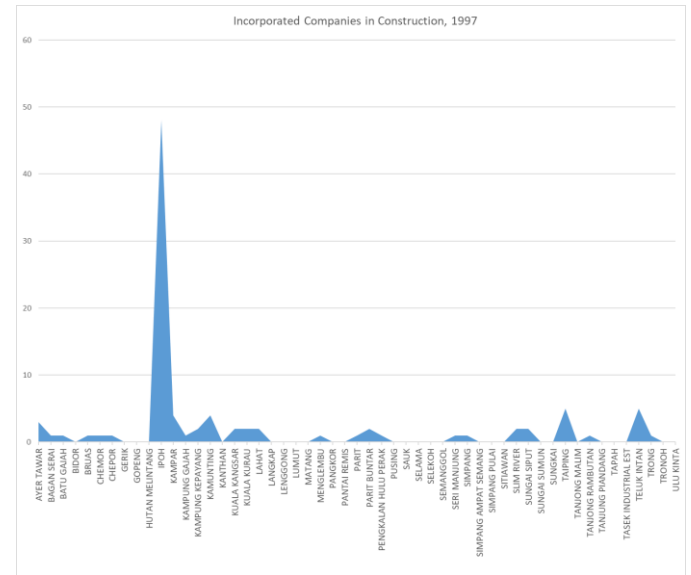
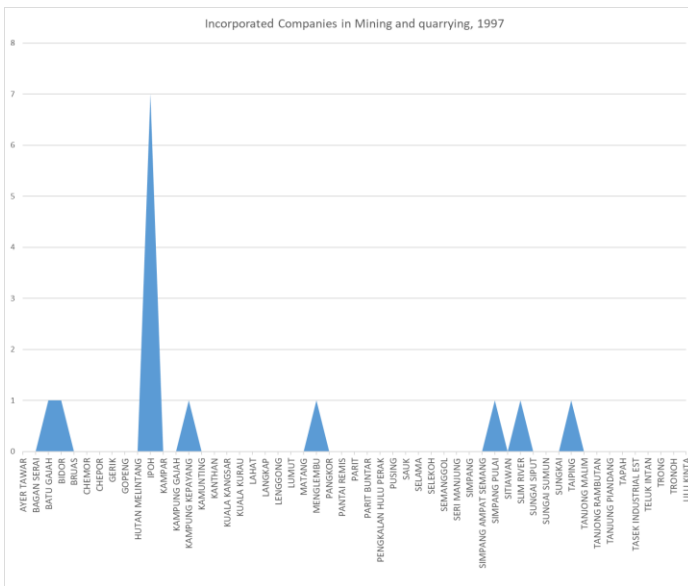
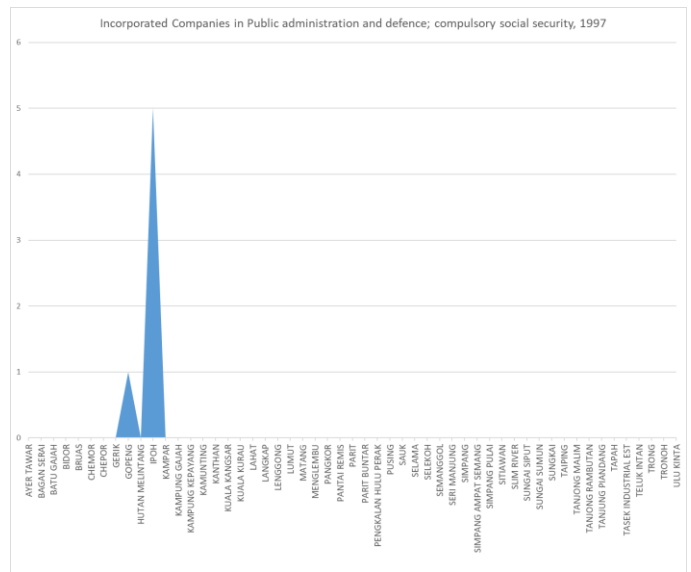
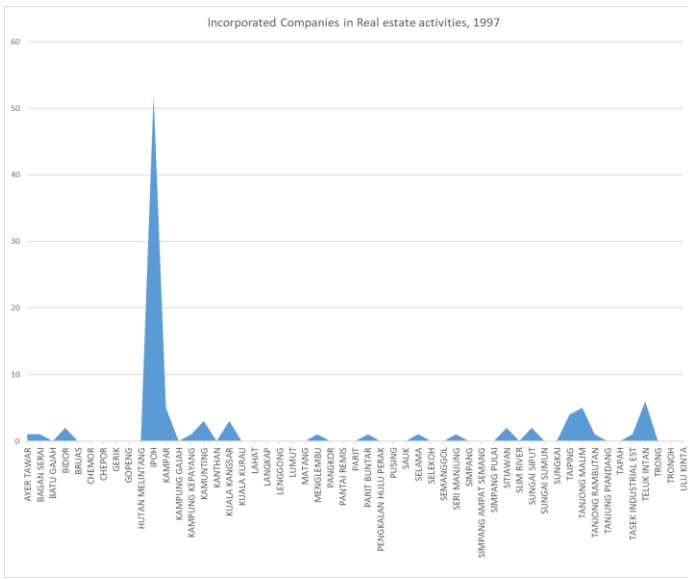


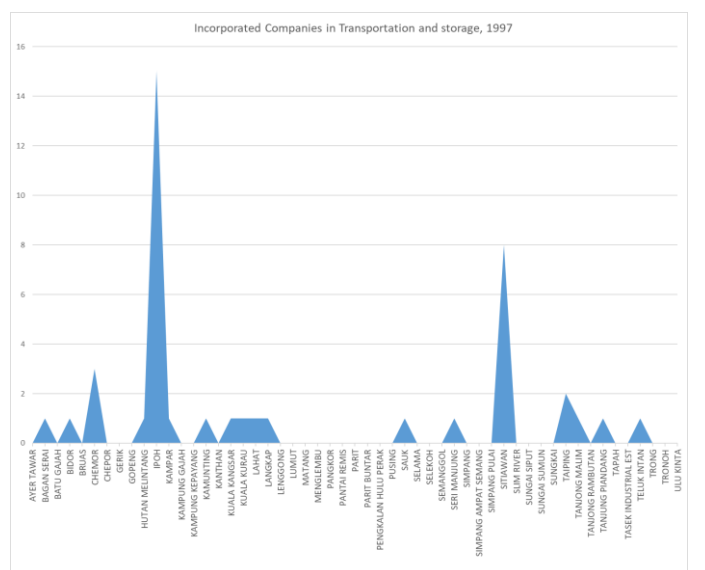
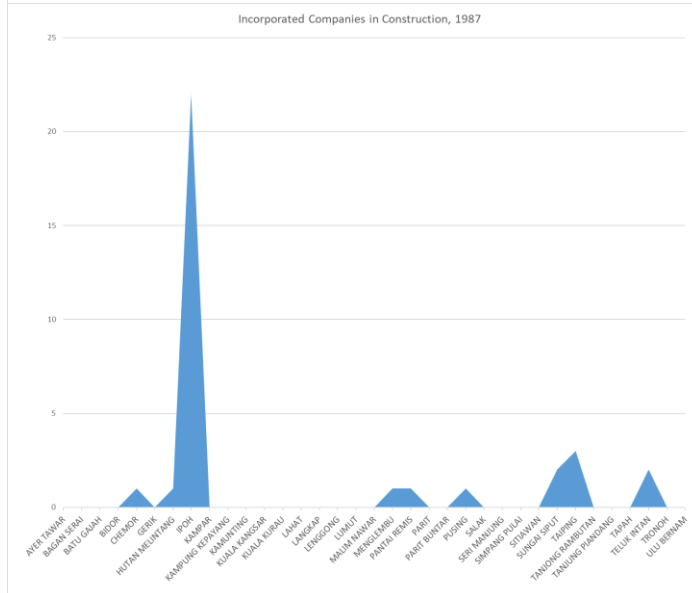
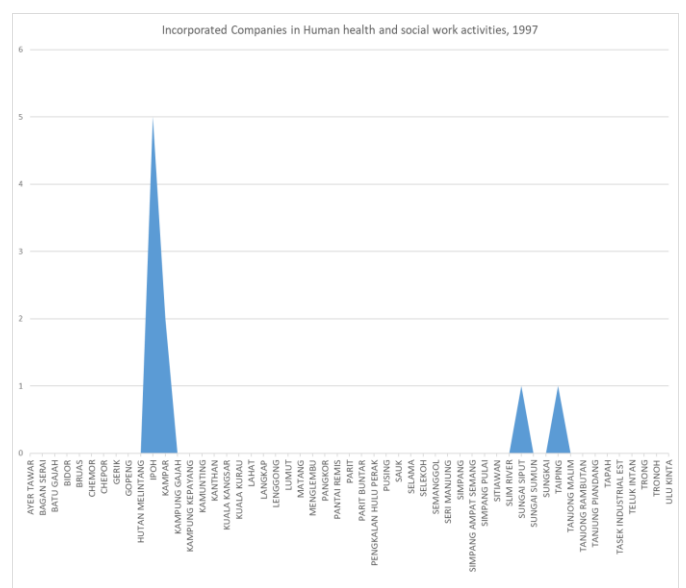
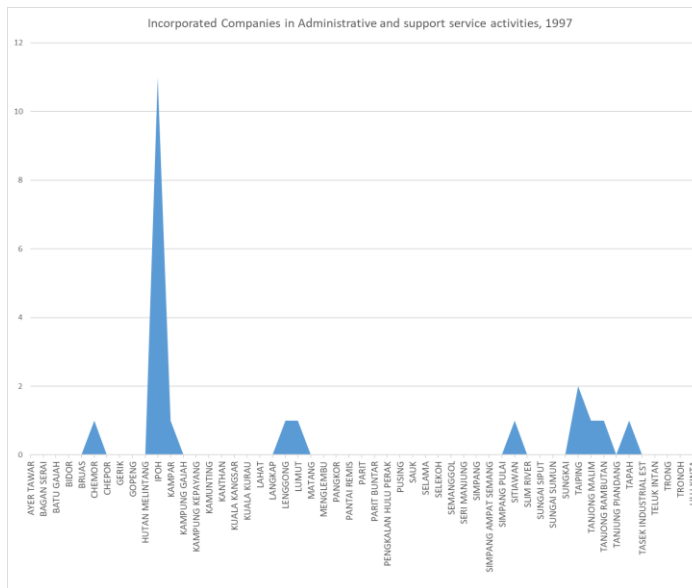
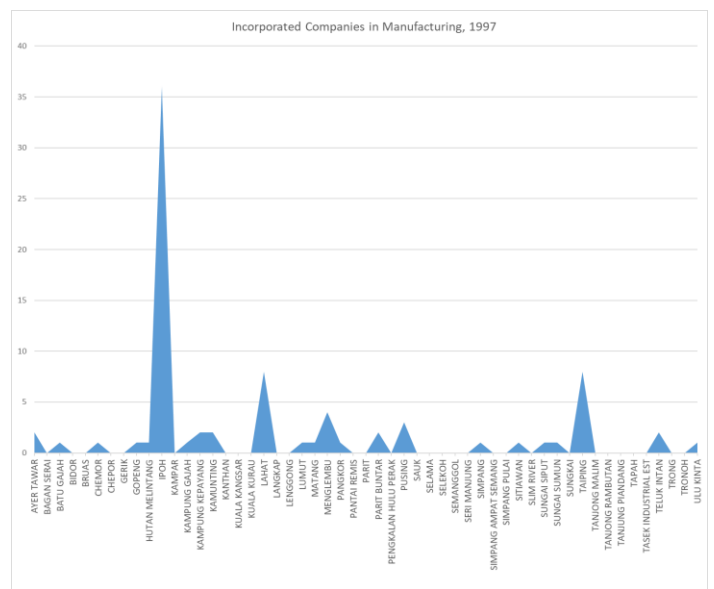
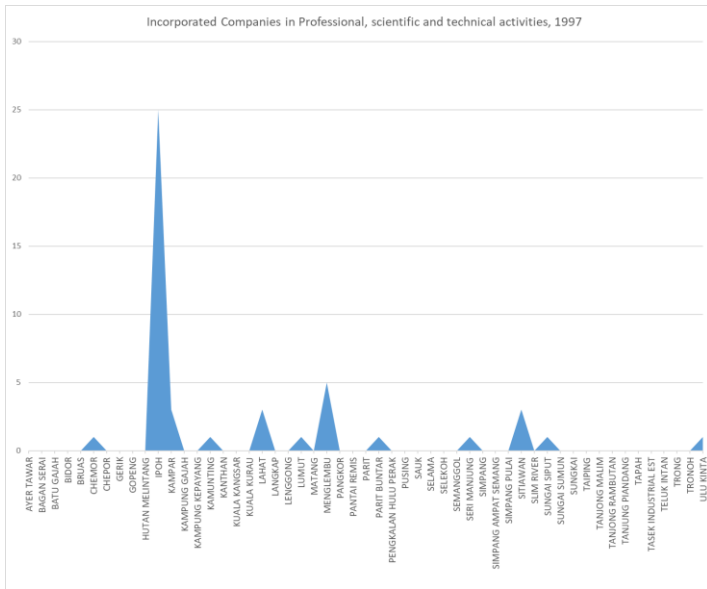


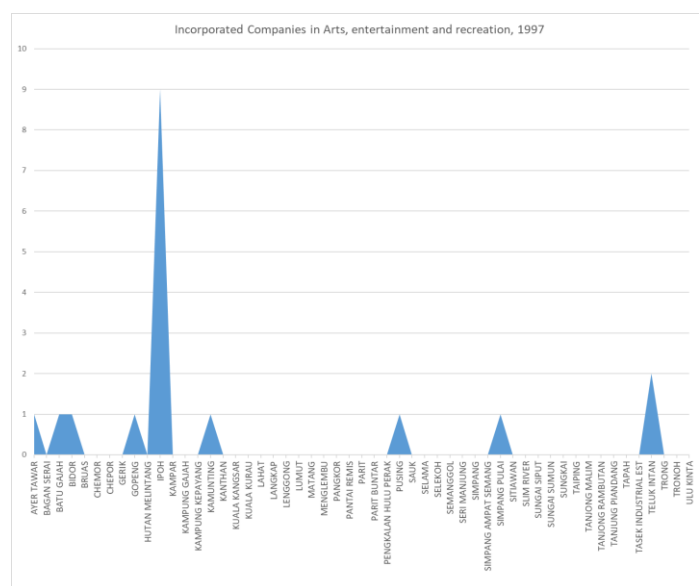
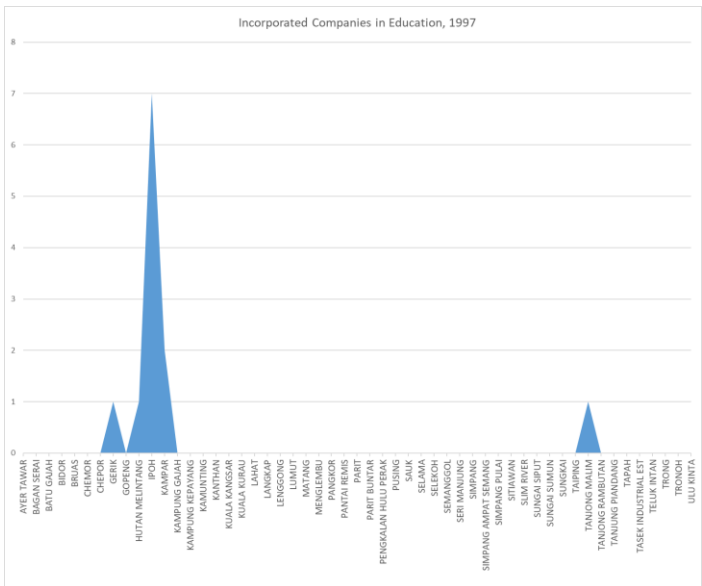
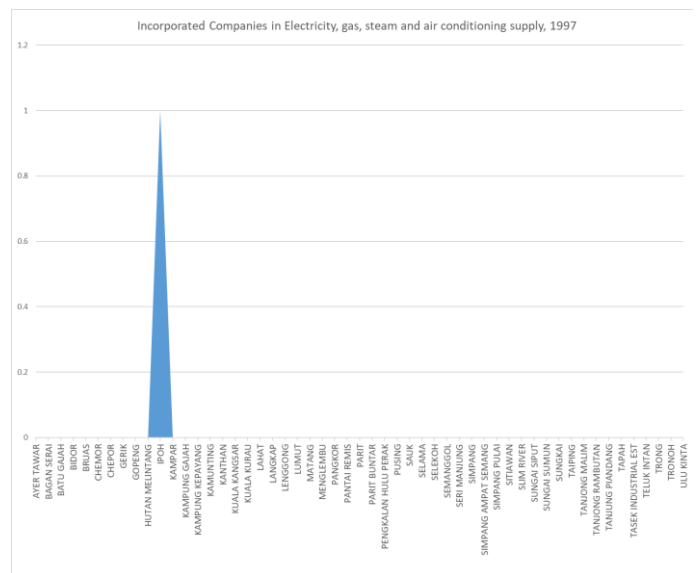
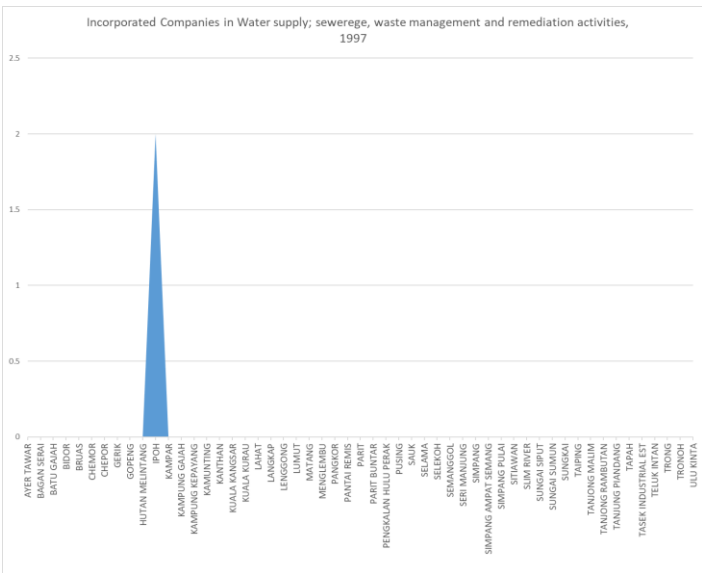
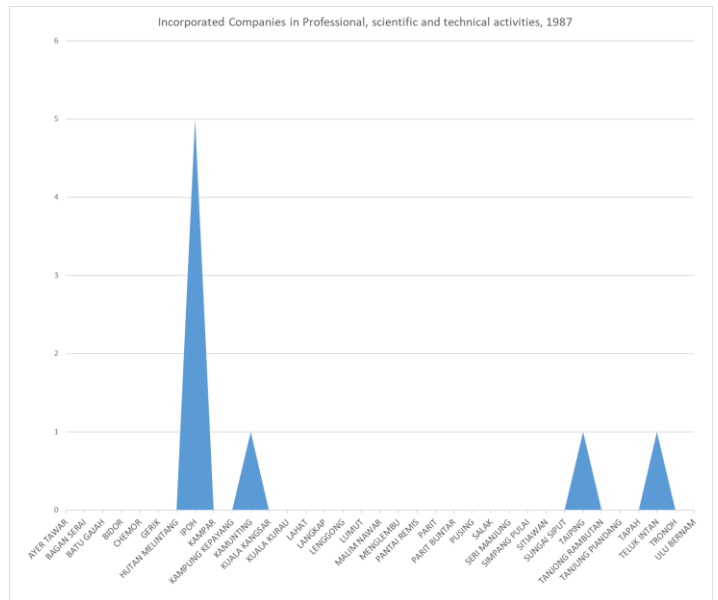
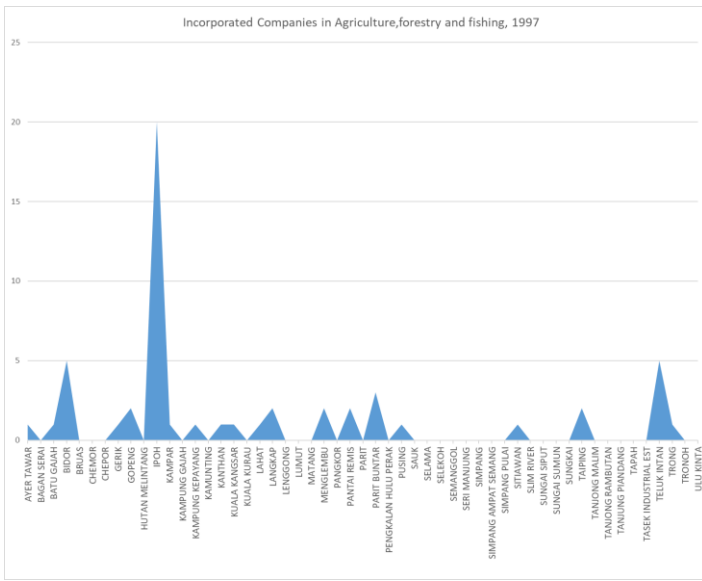


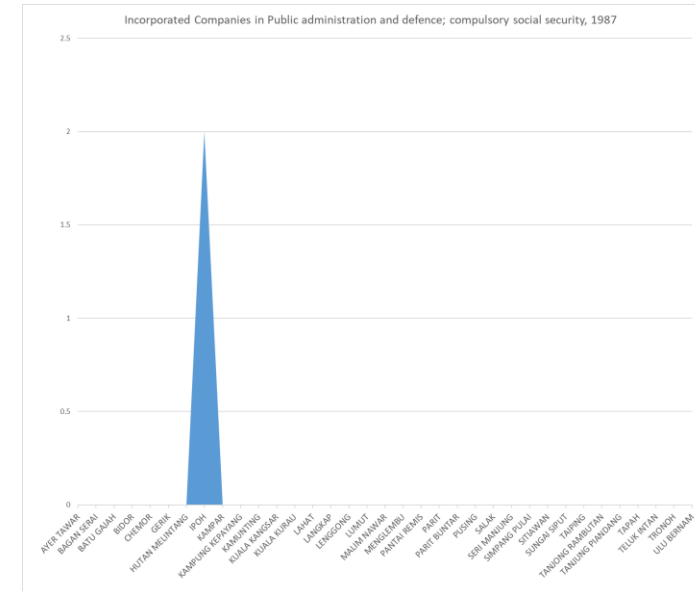
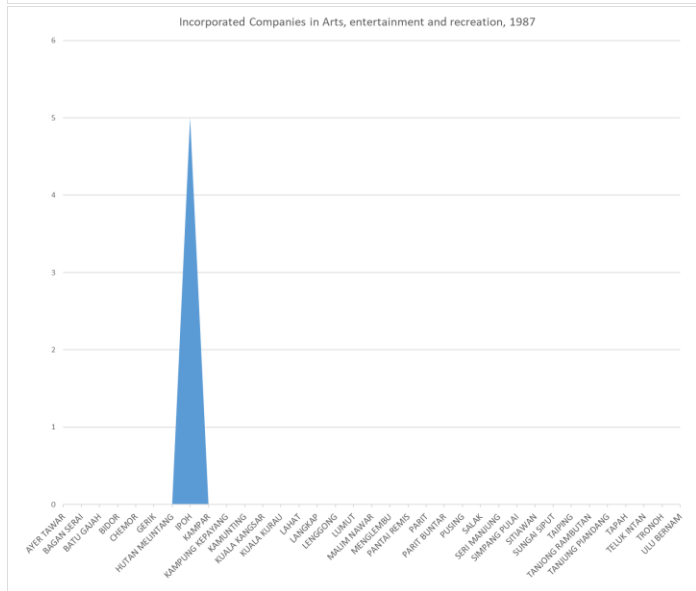
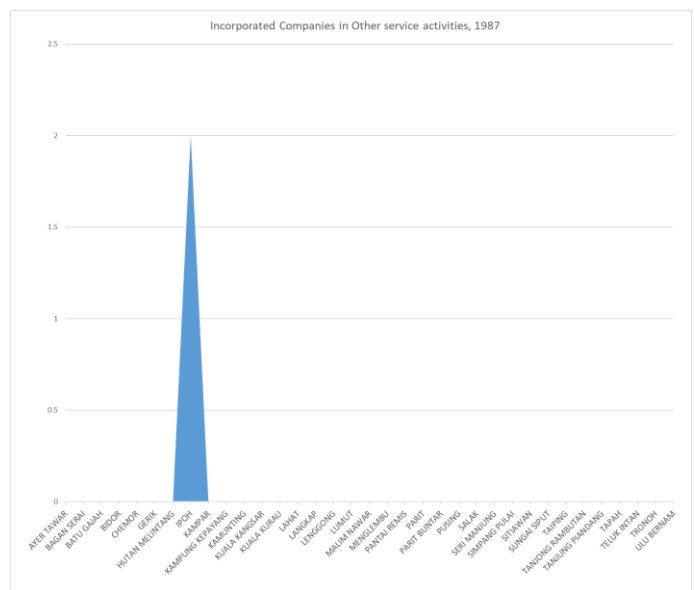
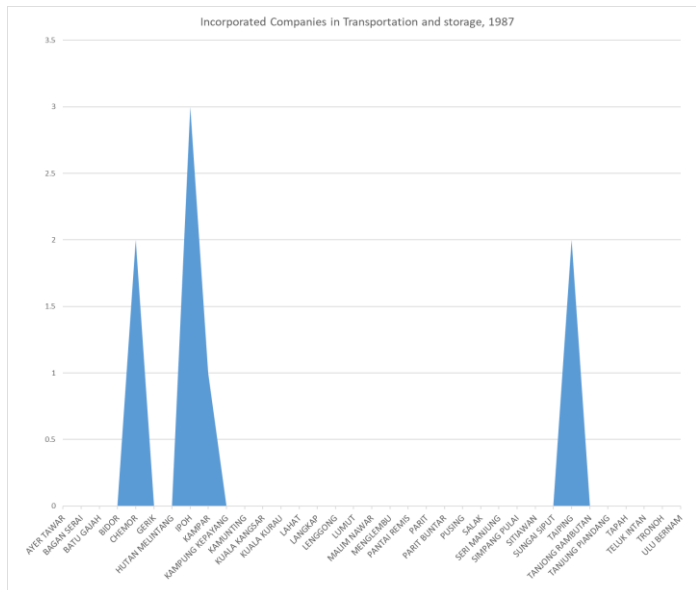
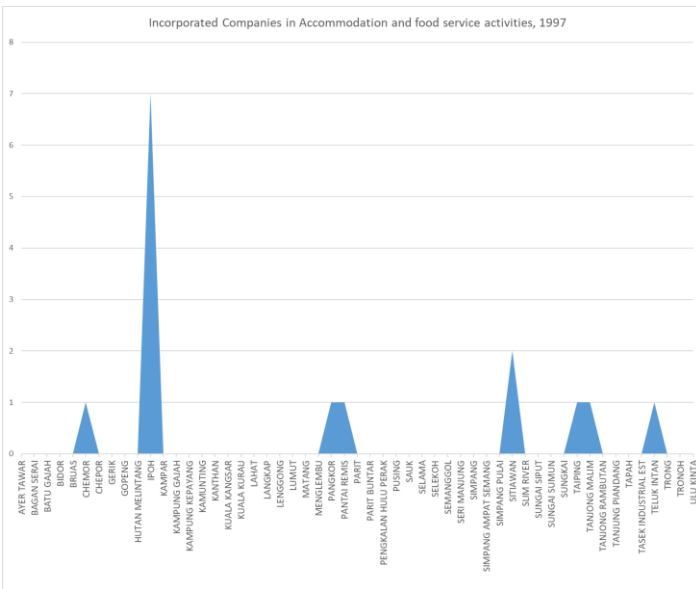


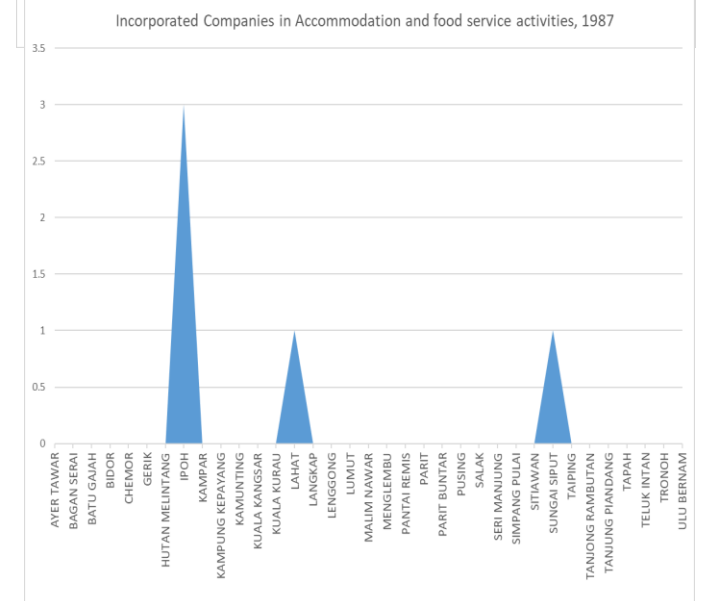
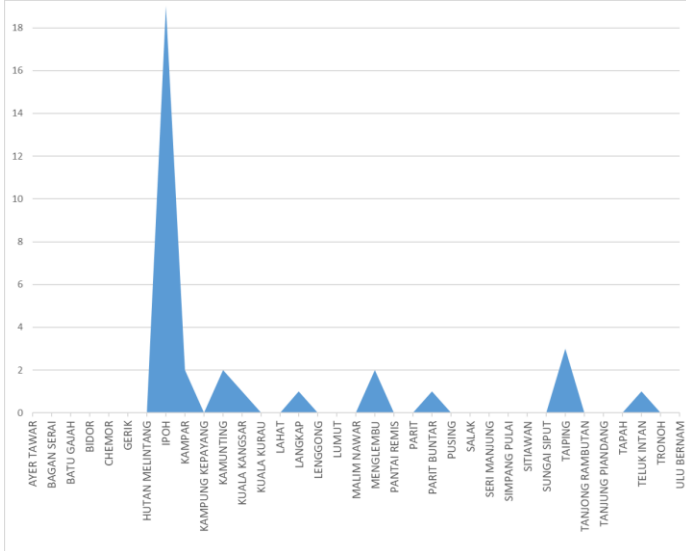
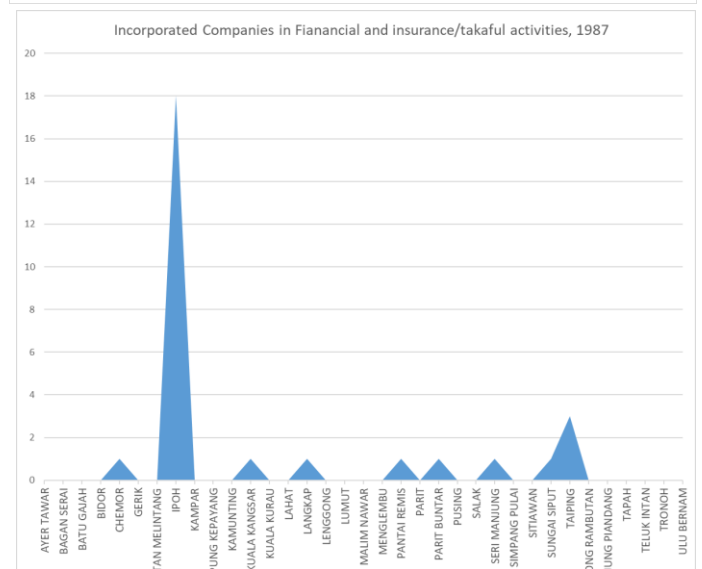
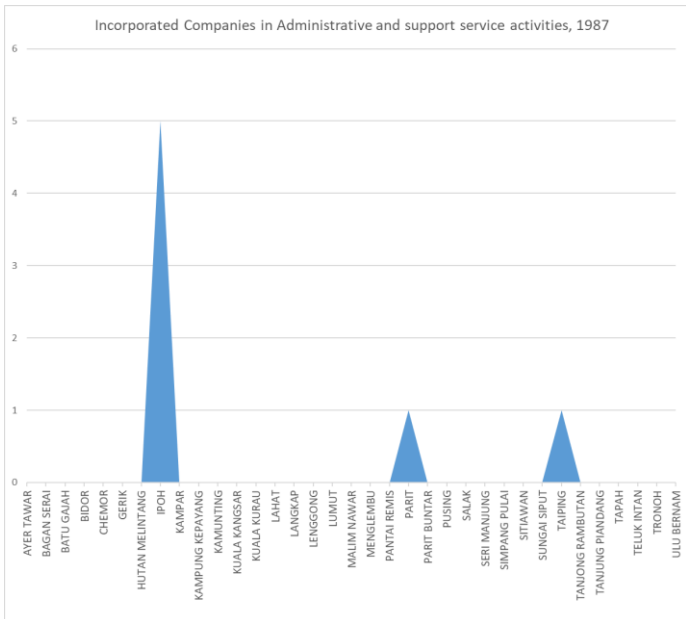
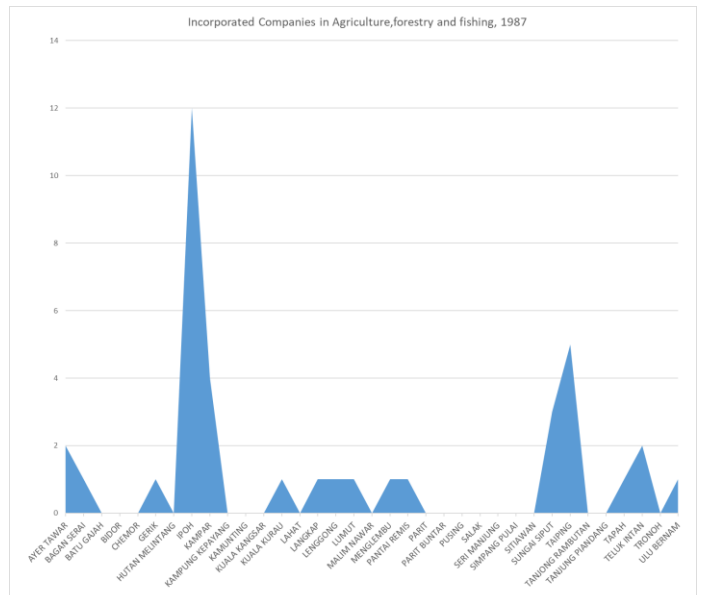
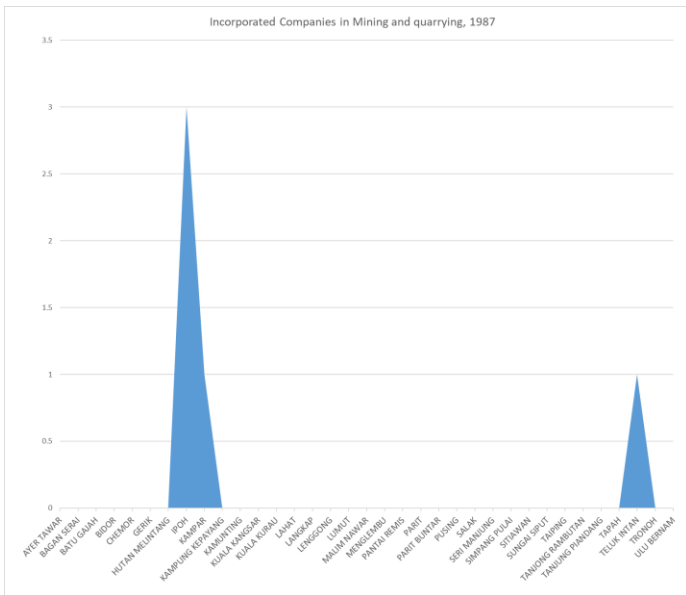


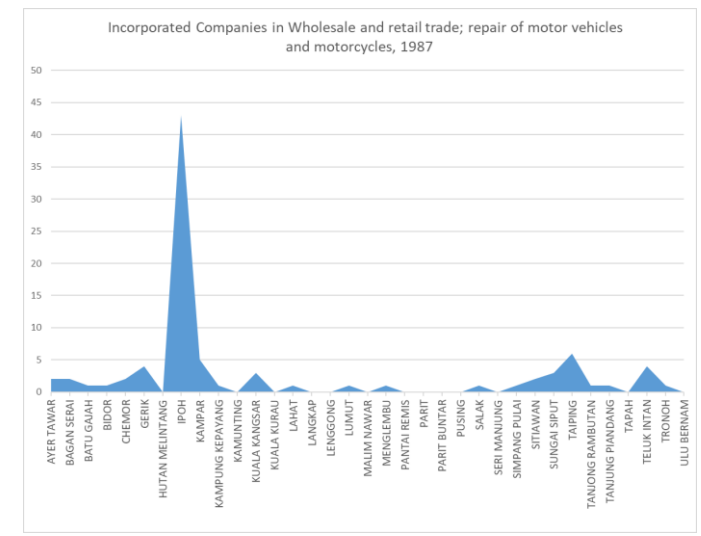
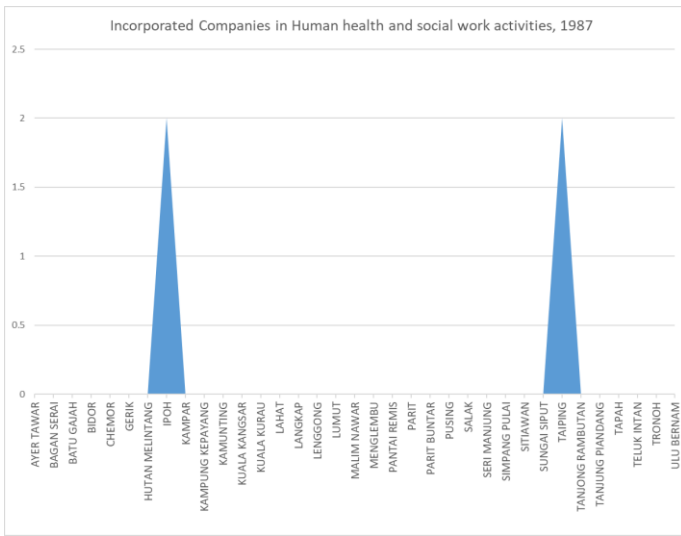
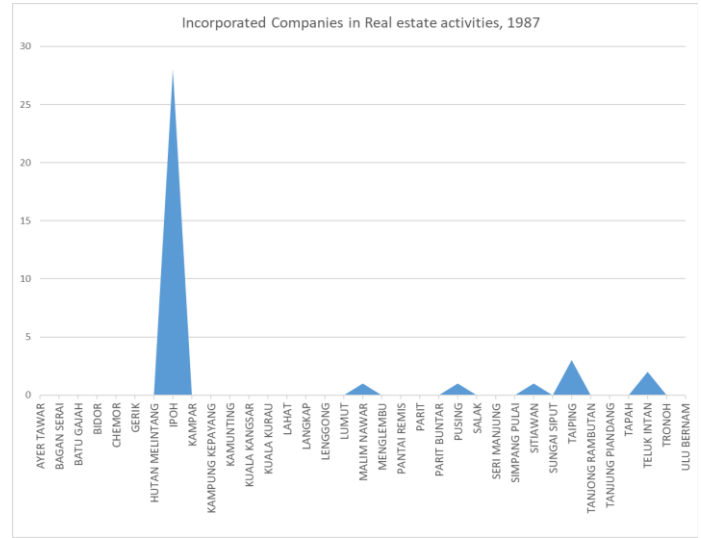
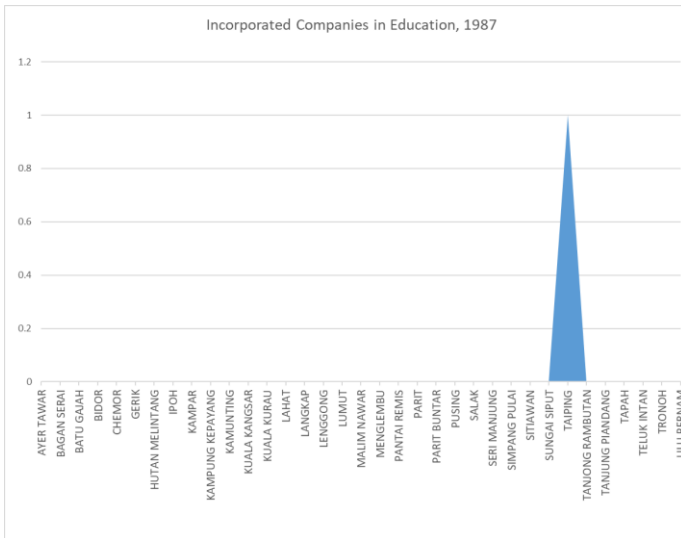




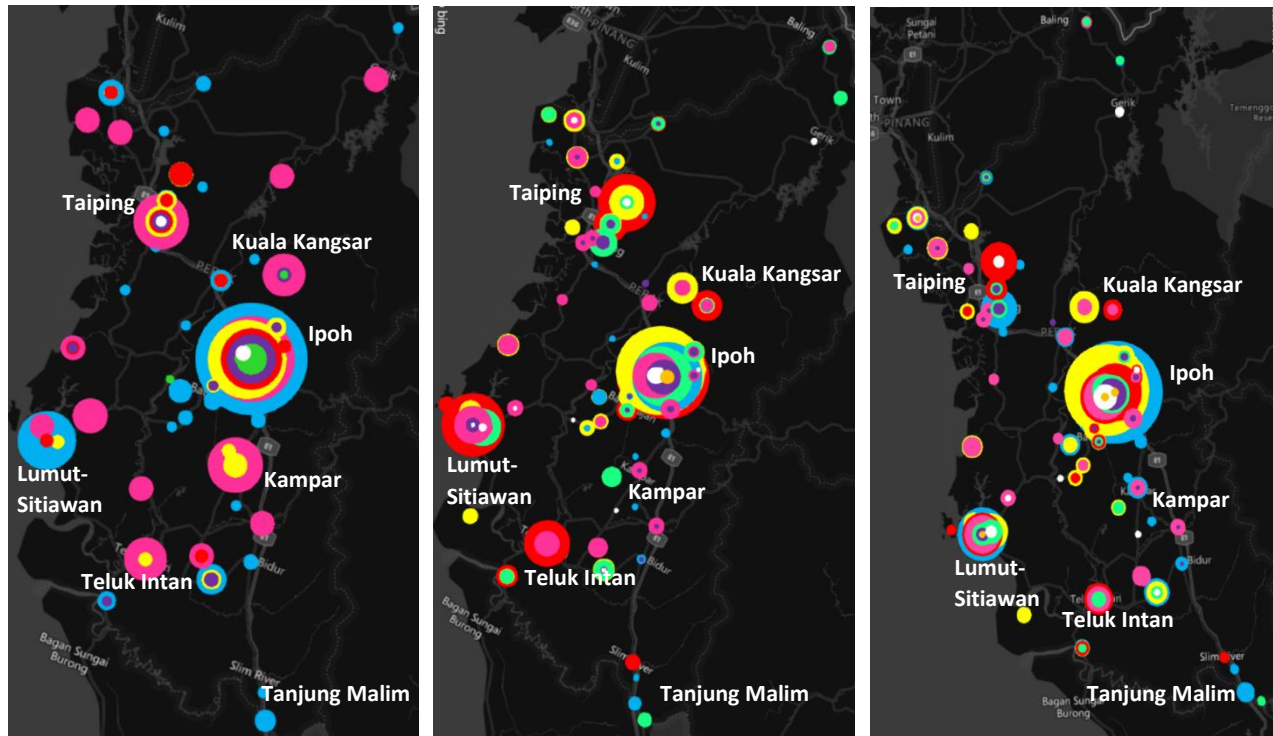








Appendix 14: Incorporated Companies per city: Geographical distribution, 1987, 1997, 2007 (SSM, 2019)



Appendix 15: Interviews with Companies

Kuala Lumpur Kepong Berhad

KLK is a Company based in Ipoh, mainly involved in the agriculture sector. Even though the majority of its activities are sited outside of the Perak region, KLK established its headquarter in Ipoh in an attempt to attract investments and stimulate economic activity. Additionally, KLK's rubber manufacturing activities taking place in Perak are mainly based around the KL-Kepong Rubber Product Sdn. Bhd. factory. Arguing that Perak lacks in terms of a stable industrial base, a secondary office was established in Kuala Lumpur, trying to exploit the higher concentration of plants and manufacturing facilities in loco, reflected in cluster and infrastructure advantages. In fact, KLK's operations in Kuala Lumpur allow the Company to operate in a more interconnected network, which in Perak is, in Dato Lee's opinion, extremely weak. As a matter of fact, KLK only cooperates with United Plantations in Teluk Intan. For the rest, there is no evidence of actual inter-firm connections and most of the relations between firms in Perak is only found in the Members of Chamber and Association of Manufacturers. Even when questioned about connections to other urban centers within the region, the representative of KLK states that such connections are almost non-existing. For instance, the Lumut Port is not seen as a regional asset, as it is considered unreliable and lacking in appropriate volume.

On a general note, Dato' Lee Hau Hian argues that the absence of a clear network connectivity in Perak, both inter-firms and inter-cities, is attributable to the lack of an economic masterplan. In fact, in his opinion, the State does not

benefit from a strong leadership and there are no promoting policies by the Government. Additional significant concerns for KLK are related to Human Capital, relevant for our analysis of labor force distribution. Many educational institutes are based outside of Perak, and so are jobs. Despite the diseconomies of higher living costs and congestion, the quality of amenities and jobs, workforce migration towards Kuala Lumpur is undeniable. This results in a brain-drain phenomenon, affecting KLK in the identification of suitable professional workers and laborers for their factories. Confirming our quantitative observation, not only the centers in Perak lack in expertise, but their labor force is bounded within specific districts, as KLK states that the majority of its employees comes from the Kinta district.

From an historical perspective, Mr Dato Lee recognizes that Perak's economy finds its roots in the advantage associated with the abundance of natural resources in the territory. This represented a competitive advantage at the State level over neighboring regions, but the absence of alternative sources of income negatively affected the growth of Perak in the long-term. Nowadays, in fact, the diversification process at the State level is evident, but there is an urgent duplication issue at the sub-regional level. In other words, urban centers, instead of leveraging specific competitive advantages to develop new tailored capabilities and economic sector, prefer investing into what are considered as highly profitable mainstream activities, such as the tourism industry. Linking this argumentation with our quantitative findings, it serves as a validation of the indication of diversified sub-regional units that lack in specific areas of expertise and tend to align to each other's over time in terms of sectoral composition.

On an institutional level, according to Dato Lee, this discourse is once again explained by the absence of tailored policies and a State-based mentality that overlooks the interconnectedness of centers and their spatial economic structure. On a final note, Mr. Dato Lee believes that Perak appears as a conglomerate of mini economies, with a clear division among districts, both in terms of economic sectors and workforce movement. This trend can only be inverted with a suitable masterplan.

Malayan Flour Mills Food manufacturing

Malayan Flour Mills is a Company based in Lumut, established in 1965. Their initial location choice is related to the specific assets that Lumut offered, mainly associated with the access to the port facility and consequent cheaper costs, as well as the relatively lower costs of land in the area. Despite this choice, the company does not make direct use of the Lumut port. In fact, because of its insufficient size and density, Malayan Flour Mills built its own Jetty, still operating to this day and utilized to export products to South-East Asian countries. This information is of particular interest as it testifies the absence of a sufficient level of specialization of urban centers. In fact, even if the city of Lumut is highly dependent on its port, such facility is not the preference of many Companies, that choose to make use of private jetties or alternative ports located in neighboring regions, such as Pot Klang, advantaged by its mass and efficiency.

On the labor force side, the majority of employees of Malayan flour Mills live close to Lumut, but the great majority of the specialized workforce needed for higher-values activities is represented by expats.

When questioned about the interconnectedness of their company with other firms in the region, Yong Yee Wan states that Companies located in Ipoh are utilized to package MFM's products, as the costs of operations in the area are significantly lower. Additionally, engineering services located in Ipoh are also exploited. This information may indicate a fitting level of inter-firms cooperation. In fact, support services in Ipoh are chosen based on proximity and cost advantages, which decreases the burden of demobilization. Nevertheless, Yong Yee Wan admits that, in terms of specialized knowledge and services, MFM needs to make use of sources external to the region of Perak. In fact, cooperation with experts from Kuala Lumpur and Johor is much more common because of their advantages in terms of expertise and dedicated knowledge, which overcome relatively higher costs associated with distance. Hereby, validating our quantitative findings, the rule the higher the level of specialization, the further away this knowledge is located from Perak.

Finisar Malaysia Sdn Bhd

Finisar is a Company based in the Kinta free Industrial zone, in the vicinity of Ipoh. It specializes in Electronics & Electrical Products, structured as a centralized system which reflects the location of their portfolio of activities. According to William Yu, the Company is supplied by firms mainly located in China, and 98% of the goods produced are exported overseas to be sold to telecommunications companies such as Cisco. Clearly, Finisar is an international-oriented company, and this feature is also reflected in the poor inter-firm connections that it has within Perak. As a matter of fact, Finisar's representative states that local firms are used mainly for packaging services, because of lower costs and transit time. Also, Finisar cooperates with Tigges, a company located in the same industrial zone, that produces screws. Nevertheless, William Yu argues that Finisar has no significant partnerships in Perak. On the contrary, the Company has some partners in Penang, where it uses local companies as subcontractors. The reason behind this choice is driven by a lack of expertise and mass in Perak, where potential subcontractors are not competitive, also in terms of pricing. Even when looking at transportation modes utilized by Finisar, inter-firm cooperation is not clear. The Company makes use of external couriers, such as FedEx and UPS, but these services are used to simply send the cargos to the airports in Kuala Lumpur and Penang. Therefore, even though these external couriers have offices based in Perak, Finisar does not make use of them. Additionally, Finisar's representative specifies that only 0.5% of their products are shipped by sea, and the rest is moved through airplanes, implying that Finisar does not consider Lumut Port as a viable distribution option. Once again, this choice indicates that distribution facilities in Perak are not suitable for Finisar, which prefers Penang and Kuala Lumpur as distribution hubs. When questioned about the choice to locate Finisar in Perak, it is answered that this decision was indeed mainly driven by tax exemption benefits and cheaper land prices, which balanced the insufficiency of other locational advantages in the region.

Talking about their workforce, William Yu states that Finisar makes use of local labor recruited from a 50-60 km range. To facilitate their employees, a shuttle bus is utilized. Also, relatively specialized workforce, such as support engineering services, is employed from the Kinta district, as Finisar considers lead time and distance as crucial factors for these types of activities. These argumentations tend to confirm the hypothesis of self-sufficient districts in terms of support services and employment recruitment.

Megah Transport Sdn Bhd

Megah Transport is a transportation Company located in the Kamunting Industrial Estate. Its main function is related to the transportation of products for Companies located in the same Industrial zone. As a matter of fact, Megah's representative states that their main clients are Latexx, Professional Latex, Eco Medi Glove and Riverstone. Goods are transported by containers on trucks which are sent to Penang and Port Klang. Interestingly, Megah Transport do not have any connections to the Lumut Port, implying that the companies they work for are not interested in making use of the Lumut Port facilities, preferring port Klang and Penang for reasons related to efficiency and mass. Once again, this confirmation validates the relatively scarcity of inter-firm and inter-district connectivity in Perak.

Ecoauto Assembly Plant Sdn Bhd

EcoAuto Assembly is located in the Industrial Estate of Kamunting since 1975. This location choice is driven by costs advantages in terms of land and materials. Also, the Government assures the Company import fee duty exemptions, and EcoAuto's products are exported to a variety of Asian countries. Similarly, the Company's suppliers are located outside of Malaysia, mainly in China. When asked about the presence of any suppliers located in the region, the Manager states that Malaysian suppliers, which constitute a very minor percentage of the total suppliers, are located outside the boundaries of Perak, where appropriate specialized services are lacking. On a similar note, EcoAuto does not cooperate with other Companies, also in terms of transportation. In fact, the Company developed its own transportation system.

When the workforce is investigated, it is found that employees come from the Larut, Matang and Selama district, where EcoAuto is located. Specifically, the great majority of them resides in Taiping. To conclude, when asked about his opinion about the inter-firm network structure of Perak, the manager states: "Ipoh is one, Taiping is one", excluding any interconnectedness scenario.

From this interview it is derived that, from a Company perspective, districts function as separate entities for what concerns workforce availability and, additionally, interconnectedness with suppliers, customers and other Companies is mainly found outside of Perak, validating the presence of an Archipelago scenario driven by a structural lack in expertise.

PKNP Group

PKNP is the investment arm of district government. In the determination of Industrial Estates' location and composition, Mr. Goradial states that PKNP is the first of four main actors. The second actor involved are private Companies which are established in the designated Industrial Estates. In fact, these private agents apply for land which they can subsequently purchase, shaping the development and direction in which the Industrial Estate develops. The third actor are local councils, mainly for the maintenance of Industrial Estates, financed with taxes. The fourth actor is the State, which owns the totality of the land. It follows that industrial land is indirectly governed by PKNP, making this agency a key player in the spatial economic configuration of Perak.

When the strategy for Industrial development of PKNP is investigated, it is found that this Government body targets districts where the highest potential for economic growth is identified. In particular, districts connected to the economic sector with most development potential and population growth are selected for the stimulation of Industrial activities. Involved in this choice are four main indicators: economic potential, urban concentration, population and supporting services in loco. Based on these criteria, PKNP has identified three districts: Kinta, Manjung, and Larut, Matang and Selama. These three locations, in fact, exhibit a relatively high demand for growth of Industrial Estates. Particularly, in the case of Manjung, not only this district shows relatively strengths in the above-mentioned indicators, but, according to PKNP, it is also advantaged by the presence of well-developed infrastructure and port facility, which are translated into transport and support services benefits.

Investigating the reasons behind the advantages that these three districts possess nowadays, a path-dependent process is unraveled. In fact, looking at the economic history of Perak, Mr Goradial argues that the presence of tin in the region can be considered as a major influence in such development. This mineral is in fact mainly located in the Kinta and Larut, Matang and Selama districts, and it is not a case that these two districts are still to this day among the most prosperous of Perak. As a matter of fact, the presence of tin in these areas was originally translated in population growth and urban development. In a second stage, when the tin industry declined, the manufacturing sector was able to act as a substitute, and related activities such as foundries, engineering services and limestone-extraction became crucial in the economy of the region.

Nowadays, Mr. Goradial believes that Perak's economy experiences a need to diversify on a State level. Indeed, this diversification process starts with the advantages that the region has in terms of natural resources, such as tin, calcium carbonate, rubber, coconut and cacao, and it is spurred by improved transportation networks and educational levels. From these advantages, there is a requirement on the State-level to diversify into other downstream manufacturing activities, in an attempt to anticipate the inevitable depletion of natural resources. Starting from a stable based built around natural resources and manufacturing, it is argued that districts in Perak will thus need to diversify and find new sources of income.

This diversification objective at the sub-regional level has certain implications for the economic spatial structure of districts. In fact, as stated by PKNP'S representative, districts become more and more self-sustaining. In other words, the same districts that were once characterized by relatively specialized economic activities are converging towards a more similar structure, rendering the cooperation between each other's unnecessary. As a matter of fact, Mr Goradial

mentions Lumut as an example of such self-sufficiency. Once specialized in the manufacturing and transportation industry, the municipality now hosts banking services, maintenance and break-down support activities, making it irrelevant to refer back to Ipoh. On the other hand, Ipoh does not have enough specialized support services to substitute what Lumut already has. In a rather simplistic way, once again, there is a lack of expertise relative to specific sub-regional entities in Perak. The only specialized hubs that remain alive in Perak are those related to natural resources. Also, some exception such as the fishing industry in Pangkor Island and the food manufacturing in Lumut are mentioned, generally motivated by cultural and historical reasons.

When the inter-firm and inter-city connections in Perak are investigated, PKNP's representative argues that, apart from transportation from Taiping and Ipoh to Lumut, no real connections at the sub-regional level are evident in the economic structure of Perak. As a matter of fact, connections external to the region are much more frequent and driven by the research of specialized capabilities that, as already mentioned, lack in Perak. As an example, Mr. Goradil states that a relatively large number of engineers employed in the neighboring region of Penang are from Taiping.

The real connections in Perak are only visible within districts themselves. Specifically, the movement of manpower is evident, meaning that people tend to converge towards bigger urban centers located in their proximity to exploit better working opportunities. This finding serves as a validation of two main hypothesis. Firstly, it confirms the archipelago urban configuration of Perak, where districts act as self-sufficient separate entities. Secondly, it underlines the already-mentioned pyramid structure at the sub-district level where, especially in terms of labor force, relatively specialized and diversified urban centers are show evidence of interconnectedness.