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台灣經濟形貌:
增進公共政策效益之動態群聚模式
Economic Landscape of Taiwan:
Dynamic Cluster Models for Public Policy Effectiveness

Student: Janet Tan

Co-Advisor: Dr. Wu, Linjun and Lin, Yehyun

中華民國 105 年 5 月 June 2016

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Abstract

Economic dynamics have been driven in a high pace, and understanding the trajectory of economics is important. Technology advancement and globalization have triggered a paradigm shift in recent economic growths from a supply-driven to demand-driven market. The change greatly impacted the policy makers' decision flow to make effective policies in a timely base. Three economic policy decision models: top-down, bottom-up, and interactive, are researched and compared in this paper to reflect the differences. This research utilizes cluster mapping framework and growth dynamics to derive Taiwan's economic landscape and agglomeration models. Through the analyses of cluster dynamism, challenges and potentials are pointed out, and a graphical tool is designed to unite policy makers, practitioners, and researchers for effective economic development initiatives. Finally, a conclusion is made with recommendations on cluster initiatives in Taiwan.

Keywords: Economic Development, Cluster Mapping, Economic Landscape, Specializations, Agglomeration, Spillovers, Supply-Chain Migration, Dynamism, Growth Analyses

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> What I've come to see as probably my greatest gift is the ability to take an extraordinarily complex, integrated, multidimensional problem and get arms around it conceptually in a way that helps, that informs and empowers practitioners to actually do things.
>
> -In Porter's 2010 interview (Kiechel, 2010)

1. Introduction

Economic development has been the most important policy for most countries since the Second World War ended because successful policies have brought prosperity and wealth. Especially, the ending of the Cold War has merged the world population into resource sharing. With over a quarter of the world population joining the competition and the latest technology explosion, competitiveness paradigm has shifted, and the game rules are changed from profitability to competitiveness. Globalization has sped up communications among people and has changed the way people live. The pace of changes is so fast that before a new technology is fully adapted by the new lifestyle, it is already obsolete. The 17th century's industrial revolution of mass production factories that guaranteed retirement to workers also has become obsolete. What is left is constant changing innovations and challenges that new technologies dominate the lifestyle change on a daily basis; therefore, changes over time, the study of dynamics, has been much in demand, especially to policy makers who decide on resource allocations for their people. In fact, the globalization is bringing everyone in an equal virtual distance; one small change may affect others far away. The longitude studies in the old time may take ten years of observations to study human behavior has evolved, and now, the timeframe is shortened and the changes are driving the dynamics so fast that the fluctuation is causing instability and shocks.

Without an exception, Taiwan's policy makers are facing the same issue in needing a dynamic assessment system for policy planning and initiative responses (Lee, Tu, Sheng, Mao, & Jen, 2010, p. 12). The policy report points out the needs for policy makers to move from a static review and information dissemination system into a dynamic response system, and moving from a top-down policy-driven model into a bottle-up demand-

driven interactive mechanism. In 2011 a recommendation report by a group of industrial researchers stated "The industrial planning policies covers many industries but lacking integrations. The current planning is based on traditional divisionary, and it is difficult to see the future expansion… There [Taiwan] is lack of bridges between the policies and industries…it is difficult for people to understand the policies(Yu et al., 2011, p. 14)." Although Taiwan's researchers and policy makers have acknowledged the needs for a dynamic assessment system, there is no evidence that the bridges are built between the policy makers and industries in the recent years.

In an interview with a machine tooling business owner[1], "The government is too slow for our trend, and they don't really understand our needs. Even if they do, they can't move fast enough to accommodate our needs." This voice has not only been heard from one field survey, but many to confirm the point. Having a dynamic response system to bridge the policy makers and business practitioners is crucially important for global competition. Taiwan is not alone on this phenomenon; likewise, other advanced countries have already built systems to compensate the dynamic challenges, such as the EU Cluster Observatory (Observatory, 2009) and the US Cluster Mapping (EDA, 2014). This dissertation provides part of the solution to a framework and tools to make industrial assessment dynamic and interactive. This research also includes a comparative study on the structural differences among Taiwan, the US and EU's economic initiatives' policy decision flows. Furthermore, Taiwan's economic landscape is presented by using cluster-mapping framework to analyze the economic dynamics.

The following chapters are organized in: 1) Research flow, 2) Contributions, 3) Literature Review, 4) Methodology and Framework, 5) Policy Decision Models, 7) Taiwan's Economic Landscape, 8) Taiwan's Economic Dynamics, 9) Regional Analyses, 10) Cluster Analyses and Case Studies, 11) Research Summary, and finally 12) Conclusion.

[1] The operating personnel of a machine tooling company in Yunlin was interviewed in Taichung on July 15, 2015. The non-profit organization of the Precision Machinery Research Development Center officer also confirms the difficulty communicating financing issues with policy makers: "the policies are set in favor of larger corporations…, but majority of companies are small and medium businesses."

2. Research Flow

The research question for this dissertation is: What are Taiwan's economic dynamics which can be analyzed for the economic development? This is a data-driven inductive research by converting Taiwan's five years' census data utilizing a cluster mapping framework to derive the dynamics of all business clusters from growth rates. Dynamic factors and relations are discussed for the framing the agglomeration models from Taiwan's industry development. Two agglomeration models are identified by the observations, and they are spillovers and supply-chain migration models. In the meantime, to answer policy effectiveness issue, Taiwan's economic policy decision model is examined against the European and the US models.

The research has been structured to answer a comprehensive question of economic development, and it involves multiple theorems. Figure 1 Research Flow shows that economic development drives the whole research, to include theories of demand-driven market, growth theory, agglomeration, geo-economics on spillovers, dynamism, cluster mapping, policy decision models, and microeconomics of competitiveness. The economic landscapes are built upon the relations of growth rates to display the economic dynamics of clusters in regions. At the end, a 3D Dynamics Analysis web-tool has been developed for the ease of use. The research flow chart is as follows:

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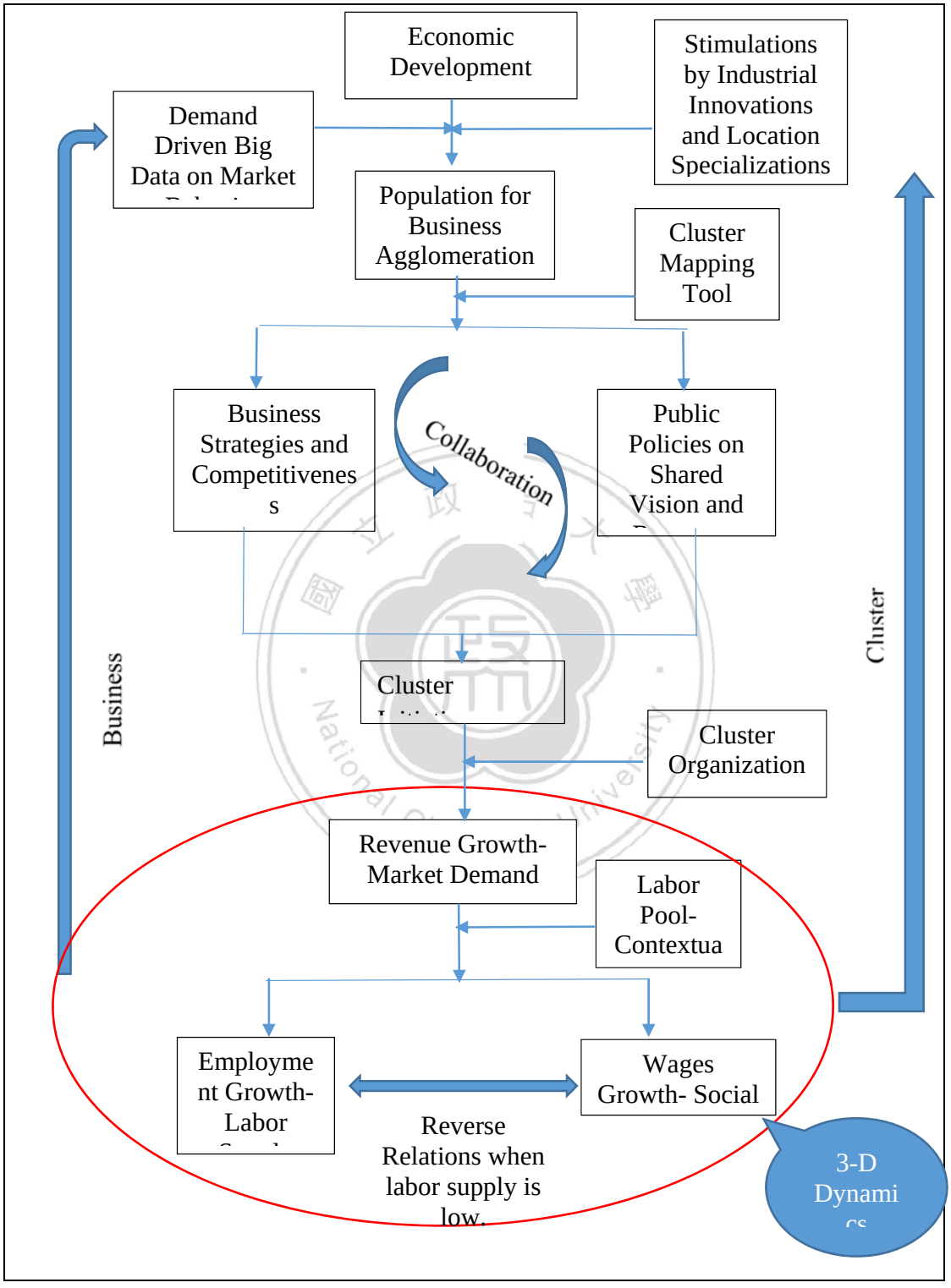
Figure 1 Research Flow: Economic structure on dynamism.



3. Contributions

Ineffective policies can stall economic progress and create social instability. While I started the research in 2008, I intended to answer the research question: what makes Taiwan economic sustainable and competitive? I researched national and international data which were either inconsistent or hard to understand. The difficulty of managing the international comparative research gave me the motivation to set a research on Taiwan's economic landscape that is to really understand what Taiwan has in the first place. Along the research, I found evidence that there is a big gap between Taiwan's economic policies and the market demands. Then, I come to the realization that there is a need to create tools to bridge the gap between policy makers and practitioners.

To answer the research questions, the research designs a tool to unite policy makers, practitioners and researchers in delivering effective industrial initiatives. By using the tool, one can clearly see Taiwan's economic landscape and its microeconomic growing paths, and make assessments for future planning and collaborations whether it is for macroeconomic policies or firm level industrial strategies. There are three parts to this research. First is to qualitatively analyze Taiwan's economic policy decision model and compares to the United States (US) and European Union (EU) models. Second is to derive Taiwan's economic landscape to present Taiwan's agglomeration models by quantitative analysis on growth dynamics. The final part is to set a model for the complex data to be presented in graphics and easily understandable charts.

The majority part of this dissertation is on quantitative analyses; the research utilizes a cluster mapping framework to assess Taiwan's economic landscape. The assessment is based on the economic dynamics from 2006 to 2011 by studying the growth factors of revenue, employment and wages to derive Taiwan's agglomeration models. The three growth factors combine to determine the two agglomeration models – spillovers and supply-chain migration. From the findings, the wage rates make the noticeable differences between the two models. The spillover model demonstrates the rising wage effect, whereas the supply-chain migration model does not. The wage is affected by the labor pool supply contextually, which the spillover model requires more skilled/knowledgeable manpower, while the supply-chain model requires lower wage

manpower. Both models face labor pool supply issues, but they agglomerate differently. Each model differs in its geographical agglomerations. The spillover model agglomerates by spreading the influences to the adjacent locations for a higher productivity, whereas the supply-chain migration model duplicates the operation model to another location outside of the region for a lower operation cost. These two models cover over majority of traded clusters' workforce in Taiwan.

The research followed its own development to reach the conclusion for this report. The research contributes to five ways, and the following paragraphs explain them in details.

First, in the qualitative analysis, the research compares Taiwan, the US and EU's economic policy decision models and displays the differences. Through the research, international economic progresses from other economies have been compared, and the result concludes that the policy decision models are different from different continents, namely Asia, Europe, and the Americas. Due to their differences on political systems, the policy decision models are structured differently. Most Asian countries are operating in authoritarian systems exercising a top-down policy decision model despite their democracy status. EU, a full democratic community, has a confederated system that tends to value citizens' demand, thus, has a bottom-up model. The US, a contemporary democracy, tends to be innovative in policy effectiveness, and has recently designed an interactive model.

Taiwan is a young democratic society still progressively upgrading its political system from the authoritarian system toward an open market system (Blundell, 2012). The transition is not yet complete, and the policy makers and people are keenly aware that Taiwan is no longer suited for a total authoritarian policy making system. The changes will take time. People have been making demands on policy-making transparency, and policy makers have been reviewing and try to improve the policy decision system. Many incidents have been calling for changes, and Taiwan is on its way for better revisions while social conflicts trigger the demands for change[2]. The 2016 presidential election and

[2] The Sunflower Movement is a demand for system changes. Young student leaders voiced for an open policy decision system, and they fought against government "close-door policy making" which may affect people's preferences.

legislative election results reflect the demand for changes on policy decision model from law to practice. It is clear that the authoritarian policy decision model is ineffective and being questioned in a democratic system. Therefore, the European and the US models are reviewed to see how do full democratic systems operate their policy decision flows to promote their economic initiatives. Taiwan, thus, can use the result of comparative studies to formulate their democratic progress in delivering a full democratic society. Of course, democracy might not be the only answer to an effective economic policy delivery system, Singapore for example has an authoritarian system and is successfully forming cluster organizations to manage cluster initiatives which can also deliver promising results. Either way, cluster mapping provides a powerful foundation for economic initiatives.

Furthermore, Taiwan has been missing out on information dissemination on important economic facts to and from international organizations, which delays Taiwan from participating the international activities or negotiations at the first-hand. This is a real big disadvantage for Taiwan. Taiwan's earlier economic rise has been replaced by the later China's economic rise. Taiwan was earlier known for its "Made in Taiwan" economic identity: cheap labor selling clothing in K-Mart which is equivalently to China sells everything to Walmart today. This makes this a joke of Walmart's name may have been started by marketing products from the Great Wall. Taiwan needs to identify its next leap strategy and rises to the next level of developed nation in order to compete globally. First-hand information is crucially important to plan for the next leap. The planning will depend on a more thorough and complete information sharing system for the general public and policy makers to work on economic initiatives together, and the cluster-mapping framework has been identified as a useful tool to be utilized. Taiwan's economic policy decision flow and policy makers' interactions with people can seriously sway the success of the economic initiatives.

Second, in the quantitative analysis, the research provides a data alignment interface in an international format that regroups existing industrial data labeling into the US and European's cluster standards for future comparative studies. The data interface is framed to derive Taiwan's economic landscape and to further analyze the competitiveness.

Recently, there are calls for big data analytical tools in all fields. Data alignments on big data from everywhere has been a part of the globalization process that one either conforms or be marginalized. There is an international awareness issue in which one can be marginalized by lack of participation. During the research, it is very difficult to find Taiwan's data internationally or data to be normalized into comparative studies. This is especially true when it comes to comparative research work that Taiwan is always out of the world's comparative maps. Labeling Taiwan is one issue; some databanks may have partial data but uses different economic labels such as Chinese Taipei, Taipei China, Taiwan China, and Chinese Taiwan despite that Taiwan is an independent economy with its own currency, but lack of data is the real problem. Of course, there are some exceptions. For example, Asia Pacific Economic Corporation (APEC) and International Trade Center (ITC) of the World Trade include complete sets of data collected for their trade documentation since Taiwan plays an important role in the international trade that the data is important not only for Taiwanese but for other trading partners.

Additionally, Taiwan is somehow hidden in the big data jungle, which fades out from time to time depending who is managing the data, and thus Taiwan's data is used for references with limited ways. This makes an economic researcher very difficult to identify Taiwan's international relations on economic topics. Hence, Taiwan is isolated not being able to participate many international trade activities due to lack of most updated information provided. Moreover, Taiwan does not appear on many important international economic comparative studies for the same reason, and this forbids Taiwan from international comparative research to be complete. Internationalization should not only be the communication in international literacy and currency conversions[3], but also community participations and project collaborations among international researchers and people regardless of the political status. Taiwan's scholars and policy makers may be from time to time participating in many international conferences and events, and they may take some leaderships in hosting international conferences[4], but they rarely

[3] Field interviews to the National Statistics Bureau, National Development Administration, and other research institutes. They recognize the importance of internationalization but are not their priority.
[4] Such as SBAOEA taking initiative in disaster resilience projects.

collaborate in international projects and release collaborative reports[5] because the opportunities are mostly occupied by China for its One China Principle.

Taiwan has its own isolated economy without a full relationship with Chinese policy makers; it is very difficult to make any international agreements or negotiations without running into a stop on One China Principle. Therefore, some network mechanisms are needed to break out the isolation to be connected directly in international economic activities for Taiwan. This research solves a small part of the solution by providing a networking mechanism with a set of international data alignment definitions (see Appendix - Taiwan Clusters Code Definitions), which enables Taiwan's data to be compared internationally. This compensates Taiwan's questionable national status and solves part of the problem for researchers to put Taiwan's economic progress on international maps.

Further evidence supports that the biggest economic challenge Taiwan faces today is negotiating Free Trade Agreements (FTAs). Every country in the world may negotiate FTA freely except for Taiwan due to its political status. Taiwan has signed FTAs with limited friendly countries, and these countries are mostly small and not as impactful in trades with Taiwan. When Professor Michael Porter visited Taiwan on October 24, 2014, and made a presentation on "Taiwan's Competitiveness", he said "There are many ways to compete besides using FTAs, and Taiwan should find other ways to deal with this." From the research field surveys, many business owners including socks[6], hand tools, and auto components industries told the vivid stories about how they lost their orders over night while their competing neighboring countries signed FTAs with the competing nations. Therefore, Taiwan needs practical tools to help policy makers and business owners to create initiatives to work on alternatives to overcome the setback from the lack of FTAs including getting in touch through international scholars in comparative research on economic trade topics.

[5] An ADB official stated in a field interview, "Taiwan's government normally avoids to apply for projects in ADB because of its official name [ROC] issue. Therefore, there are no projects for Taiwan. We have no problem granting Taiwan projects because they are a full member of ADB."

[6] The business owner of Black Dog Brother in Shetou with a site interview in 2012.

Third, the research derives Taiwan's economic landscape by utilizing a cluster-mapping framework to analyze industrial dynamics. The research defines Taiwan's cluster code. Two sets of Taiwan's census data were extracted for the study of agglomeration and growths. Fortunately, the data contains a period of a global financial shock, and the clusters' analyses captured Taiwan's economic landscape closely on the dynamic shift after the shock. Taiwan, a small economy with limited endowments, survived the 2008 global financial crisis and its ripples. The wealth of data is worth for the resilience analysis. The external shocks changed Taiwan's economic landscape and created opportunities for those who were well prepared. An assessment is due to describe the changes with an accurate framework. The survival is as important as what have been failed, and how have been succeeded. The lessons here can be set as a model for other economies to be researched.

Fourth, this research analyzes Taiwan's agglomeration models and potentials. This research includes the recent census data from 2006 to 2011 with a real external shock - the 2008 global financial crisis. With the shock, the data is rich to measure Taiwan's economic sustaining power. This gives an excellent backdrop for the research to present the results from the two extremes, prosperities and challenges. Taiwan, after the global financial crisis has a new economic landscape. The changes reflect the strengths and weaknesses in each cluster and city (here, city is defined as Taiwan's geographical divisions of cities and counties). Taiwan's cluster mapping data could accurately present Taiwan's industries' dynamics based on three sets of growth rates (employment, revenue, and wages) and their relations. The agglomeration research contributes to the theoretical constructs in differentiating two types of industrial agglomeration models, and by using the inductive research method to define the relations among these growth rates to analyzed the agglomeration potentials.

The two agglomeration models are supply-chain migration and spillovers models. For the supply-chain migration model, Taiwan is famous for making Apple products, especially after the world financial crisis of 2008, companies such as Foxconn profited from the hot selling market of iPad and iPhone. Foxconn stands for its branding in OEM (Original Equipment Manufacturing) making electronic products for brand marketing companies.

The company is a Taiwan's success story built its business from a precision machinery company from ground-up to an OEM. The company is famous for its low cost and high quality productivity that helped Apple to be richer than its own country. In 2011, Foxconn got even more famous by the employees' suicide incidents that people started to notice the company with over one million employees in China actually was a Taiwanese company. Today, Foxconn acquired Sharp, a Japanese Corporate, who made the first LCD television display was failing, and the merger and acquisition finally came through after a long negotiation[7]. The successful growth path of Foxconn is evolving from a production company into a production management company; its winning strategy is to involve most of its vendors to migrate with as a group (supply-chain cluster migration) and utilizing modulized production line to rebuild and reshape its production workforce with precision and produce quality products and high efficiency. Although, its net profit margin is only around 2%, Foxconn is the world largest manufacture producing the highest quality products.

The second model is the high-tech knowledge-based spillovers model. When talk about OEM, one cannot ignore Taiwan Semiconductor Manufacturing Company (TSMC), the company is making to the top ranking in the semiconductor industry with a net profit margin of 35%. This is comparatively much higher than the supply-chain migration model of 2%. The semiconductor industry is a fast growing cluster with very high average wages. The dynamic effects of spillover will be shown in the cluster maps in the Spillovers Model - IT Cluster.

Taiwan is not without private brandings. One industry worth mentioning is Taiwan's pride in bicycles, the Giant and Merida. Giant has earned its international brand recognition for its quality and creativity. The bicycle branding suits for the spillovers from the marching tooling industry. Both Foxconn and TSMC are all production companies that they all started their businesses by contract services. All these companies have one thing in common; they started from the Production Machine cluster. Therefore, machine tooling industry is the important backbone for Taiwan's prosperity today.

[7] http://fortune.com/2016/04/02/its-official-foxconn-and-sharp-inked-their-deal/, retrieved on 4/28/2016.

Thus, Taiwan is an excellent place to study OEM businesses agglomeration. Foxconn utilizes the strategy of enlarging the labor pool by migration and relocating the supply-chain clusters, and TSMC is part of a dominated and dynamic cluster based on knowledge creations and spillovers. Their common bases are both related to the supporting clusters of machine tooling industry on precision machineries and automations. Besides the agglomeration models, Taiwan sets the entrepreneurship model from bottom-up rising to the top. Taiwan has 97.6% Small and Medium Enterprises (SMEs), and the most successful companies started from ground-up. In this research, Taiwan's economic landscape has been built upon from its local specializations into the agglomerations of the world OEM manufacturers by the people and their entrepreneurship. Thus, Taiwan's clusters provide good development paths for entrepreneurial agglomeration.

Fifth, for the ease of use component, this dissertation is written for readers across the board, for practitioners, policy makers, and researchers and wishing to make some influences to the globalization changes. A graphical web display tool is provided for an easy access to the cluster maps[8]. This is a comprehensive data-drive research utilizing data from various Taiwan's national data banks and data from other nations such as national accounts, labor data, and trade data. In the meanwhile, the research records the descriptive surveys on the research process because the process itself is a living document for the research development, and this report may be used as teaching materials.

4. Literature Review

> A nation or region is competitive to the extent that firms operating there are able to **compete successfully** in the regional and global economy while maintaining or improving **wages and living standards** for the average citizen.
>
> – Michael Porter[9]

Industry matters when it comes to labor productivity. Prior research indicates that the impact of human resource system on productivity is influenced by capital intensity,

[8] http://tisc.nccu.edu.tw/bubble
[9] In his speech on Oct. 24, 2014 in Taipei on "Taiwan's Competitiveness."

growth, and differentiation (Datta, Guthrie, & Wright, 2005). For this research, the industry differentiation and the capital intensity are characterized by grouped industrial clusters. The research uses a multi-factor approach utilizing aggregated firm level data to derive economic landscapes by analyzing industrial clusters growth among revenue, employment, and compensation data sets. For a business, these three factors are most important for day-to-day operations. Revenue is the most important input factor for a business. Compensation is used to gauge how well a business is operating. Compensation-to-revenue ratio is what company used to assess how profitable a company is[10], also a measure to the labor productivity for a business operation (The Goldman Sachs Group, 2011). Employment is a measure to the workforce participation for a region. Average wages are calculated based on compensation and employment and serve as a factor to evaluate clusters' employment demand. The growth rates of these factors are used to measure industries' performance and derive regional economic landscapes. The value delivered in this research is embedded in the mapping of the various clusters from each of the regions.

There are five major components to the analyses. First is the comparative studies of economic policy making decision models; second is to define Taiwan's cluster codes. Third is to derive Taiwan's economic landscape by drawing data from Taiwan's census data bank. Fourth is to identify Taiwan's agglomeration models by analyzing economic dynamics data. The research utilizes the US Cluster Mapping framework to derive the maps of Taiwan's economic landscape. Finally, a programed tool is designed to show the maps for easy reading. The graphical assessments are based on the economic dynamics from 2006 to 2011 by studying the growth factors of revenue, employment and wage rates to derive Taiwan's agglomeration models. For the comprehensiveness, the research involves several theoretical backdrops to support the methodology. The literature review on each theory is listed as follows.

[10] http://www.hvacrbusiness.com/how-much-of-earnings-spent-on-payroll-and-taxes.html, retrieved on 4/28/2016.

4.1. Economic Growth

Economic growth in general is measured by the growth of Gross Domestic Product (GDP) or GDP per capita, but it is not enough to tell the dynamics of an economy. The latest literature has been focusing on comparative economic growth in the globalized world (Acemoglu, Akcigit, Bloom, & Kerr, 2013; Fagerberg, 2013). There are numerous economic growth theories from Schumpeter's innovative destruction to labor participation empirical studies, which confirms the spillover effect on economic growth (Acemoglu et al., 2013; Aghion & Howitt, 1998; Lentz & Mortensen, 2005, 2008). This research enriches the spillover research with empirical data of Taiwan's dynamism to show the relationship among the growth rates. Theory also confirms that labor moves from lower to higher pay jobs (Lentz & Mortensen, 2005, p. 3) Borrowing from Schumpeter's economic development theory and business cycle (Schumpeter, 1934, 1939), the user demand is the foremost important factor to start in his theory, followed by population which is the agglomeration criteria, and the following are the products, finance and organization. Innovation is stimulus to trigger the destruction to the business cycle which adds the momentum for market expansions and job creations in a cyclical way. The first two factors, user demand and population are the representation of revenue and employment. These two are also the most important factors for businesses gains and jobs. Jobs are affected by the labor supplies, and the wages reflect the labor pool conditions, which sets the inductive reasoning base for this research.

4.2. Economic Landscape

The economic landscape once built describes the shares of employment in each industry and in each region. From the US Cluster Definitions, each industry is clustered in simulated groups by utilizing the cluster-mapping framework (Delgado, Porter, & Stern, 2014), and political borders are regrouped into industrial districts by correlated growths. The economic dynamics provide the factors to assess how industries are doing from the perspectives of regional growths and cluster growths. Since the US Cluster Definitions is used to build the foundation of the economic landscape, Porter and related researchers' work are cited thoroughly in later details. The multifactor dynamism analysis is new to the field of economic modeling: it is assessed by the cluster maps, which is designed for

the non-statistical readers to see the graphical landscape and an added value to economic quantitative analysis.

4.3. Agglomeration

The dynamics of industrial agglomeration are important for business sustainability, especially in the mass production industries. (Cortright, 2006; Delgado, Porter, & Stern, 2010; Delgado et al., 2014; Feldman & Audretsch, 1999; Feser, Renski, & Goldstein, 2008; Glaeser & Kerr, 2009; Neffke, Henning, Boschma, Lundquist, & Olander, 2011; Porter, 2003; Rosenthal & Strange, 2004) Agglomeration is also important for the spillovers of knowledge and value chain sourcing. But where can people find the information and resources? In the old days, imbalance of information exchange gives hidden opportunities to make higher profit and owning the private market channels. With the recent data opening and information sharing, the world is demanding on the ease access of presentable formats. Romer (1993) stated "For many years, the use of formal mathematical models kept them from being able to talk about the economics of ideas in aggregate level discussions of growth and development. Cluster theory advocates building on emerging concentrations of companies and encourages the development of these fields with the strongest linkages to or spillovers within each other. (Porter, 2008, p. 223)

Innovation is another important factor in measuring potentials for agglomeration. Clay Christensen's disruptive innovation may be great for competition, but it also causes instability for some (Christensen, Horn, & Johnson, 2008; Christensen, 1997); hence, innovations can be a stimulus versus the most important factor. US patents are a good gauge for global innovations; Taiwan ranks 4th globally in terms of innovation from the US patent filings, which is an added advantage to Taiwan.[11] This gives Taiwan a fairly good background for the foundation being competitive and its growth.

[11] US IP reference web-link.

4.4. Economic Clusters

Economic cluster research started as early as when Alfred Marshall use “industrial district” in his Principle of Economics (Marshall, 1920). Cluster research has evolved from the earlier Marshall’s industrial district (Marshall, 1892, 1920) into today’s multi-industrial networked analysis namely Clusters Mapping (Delgado, Bryden, & Zyontz, 2015; Porter, 2003). Industrial agglomeration has been an important study of economic geography especially in cluster research (Delgado, Bryden, et al., 2015; Delgado et al., 2014; Ellison & Glaeser, 1997; Krugman, 1990; Marshall, 1920; Porter, 1990a; Porter, 2011). There are three important drivers of agglomeration, input-output linkages, labor market pooling, and knowledge spillovers, which are associated with cost or productivity advantages to firms (Marshall, 1920). Porter has hence refined the cluster’s definitions and tested the definitions with rigor, and this is reason why this dissertation is adapting to the framework of cluster mapping. Below are more details on Cluster Mapping development.

On a cluster formation, local market and specialties support the cluster’s vitality is important. Earlier studies have contributed to the understanding of clusters on competition, and agglomeration economies stresses input cost minimization, input specialization made possible because of the advantage of close to the front of markets learning firsthand in market demands and acceptances. (Porter, 2008, p. 223) Yet, diminishing returns to specialization in a location can cause convergence effect, which means the growth rates can be declining in a cluster. On the other hand, positive spillovers can provide the impetus for agglomeration (Delgado et al., 2014). Therefore, analyzing specialization within a region, growth rates, and their interactions are important to see the potentials for cluster’s spillovers or in convergence. Thus, measuring the rate of changes is an important part of this research. This research focuses primarily on dynamics, and the dynamics of a cluster are understood by the relations of the growth processes. In other words, by understanding Taiwan’s economic growth patterns, one can derive the cluster initiatives to plan for the next trajectory.

Successful companies combine internal excellence with a presence in strong locations and clusters that leverage their strengths (Ketels, 2007, p. 7). In order to compete more

effectively, regions need to understand their cluster strengths when compared with those of other regions (Porter, Ketels, & Delgado, 2007, p. 33). Initially, Porter uses the standard group of the NAICS-3 (The North American Industry Classification System) code do as the cluster definitions, but the cluster groups correlate badly since it is mostly defined to group products and services not based on the inter-industry complementarities (Delgado, 2007, 30). Limitations on using the NAICS in other economies that are weighted toward economic activities that are less prevalent in the US (e.g., ship building) or that is not well captured by US data (e.g., farming). They may also be less useful in countries with a lower level of technological development. (Delgado, 2007, 34) The core dataset is the city-level enterprises' basic measure of its economic performance, covering employment and data associated with its standard of living. The NAICS codes may not contain the linkage relations among related industries, therefore, Porter and his team regrouped the code into a new set of Cluster Definitions (See Appendix - The US Clusters Code). Taiwan's industries are very similar to the US NAICS codes, and therefore, by adopting to the US definitions is a natural transformation of Taiwan's cluster codes (See Appendix - Taiwan Clusters Code Definitions).

4.5. Cluster Mapping

In this research, closely related industrial groupings are mapped on 3-Dimentional graphical charts. Porter defines clusters as geographic concentrations of interconnected companies, specialized suppliers, service producers, firms in related industries, and associated institutions (for example, universities, standard agencies, and trade associations) in particular fields that compete but also cooperate. Critical masses of unusual competitive success in particular business areas, clusters are a striking feature of virtually every national, state, and even metropolitan economy, especially those of more economically advanced nations (Porter, 2011, p. 197).

In the earlier criticism when cluster concept was proposed by Porter in the 1980s, Porter received numerous criticisms. Porter offered an industry relational definitions of clusters including many functional divisions, categories, descriptions which is complex without explaining in the algorithms in his earlier writing which added confusion to other scholars. On the other hand, Porter's cluster research was overwhelming well received by

policy makers (Asheim, Cooke, & Martin, 2006, p. 3; Martin & Sunley, 2003). Researchers complained and contributed to a book of criticism collectively (Bathelt, 2008). Criticism ranged from “vague theoretical framing,” to “enormous confusing”, “too broad,” “one-size fits all” (Asheim et al., 2006, pp. 12,14,21). A similar term used in the Italian economic, “industrial districts,” has also stimulated a wide international debate about the competitive performance of these specific geographical concentrations of “localized industries” (Belussi, 2006, p. 69). Belussi continued to criticize Porter’s cluster concept indicating that “Most of the literature lacks sufficient power of theoretical generalization, and testable regularities are not precisely identified.” Furthermore, “Quantitative analyses have used spurious data bases, and research conducted on individual case studies confuses the two levels of analysis: the idiosyncratic component, related to the obvious specificity of territory examined, and the studied ‘clustering effect’ (Signorini, 1994) deriving exactly from the features of the phenomenon treated.” (Belussi, 2006, p. 71) Ivana Paniccia criticized that Porter “put forward a concept which lacked precise conceptual boundaries, so that the term, according to the critical appraisal by Marin and Sunley (Martin & Sunley, 2003), has acquired such a variety of uses, connotations and meanings that is has, in many respects, becomes a ‘chaotic concept’, in the sense of conflating and equating quite different types, processes and spatial scales of economic localization under a single, all-embracing universalistic notion.” Time has come to the proof that Porter is way ahead of his time in the earlier years trying to describe a structure to close the gap between the policy makers and practitioners. That is why policy makers welcome his presence and ask his help to reach out to public. Now that he has much more to offer after years of analytical framework being drawn in a much precise and versatile way (Huggins & Izushi, 2011; Ketels, 2011). Through the framework, the research is able to induce Taiwan’s economic models by spillovers effect and clustering of supply-chain effect.

4.6. Spillovers

Numerous research has confirmed spillovers are an important agglomeration effect (Audretsch & Aldridge, 2008; Audretsch & Feldman, 1996; Canina, Enz, & Harrison, 2005; Chyi, Lai, & Liu, 2012; Fallah & Ibrahim, 2004; Jun & Guanghua, 2006;

Nooteboom, 2006; Rugman & Verbeke, 2003), and most studies are either empirical case or technology spillovers on innovations. This research contributes to the cluster spillovers from the adjacent clusters by the overflowing business and employment demands. The spillover is defined, in general, to as an industry that shares resources and knowledge with another industry such as common labor skills that may be used by both industries, or an over flow of knowledge from one industry to another industry. Adding to the general definition here, spillover is defined to be the adjacency employment overflow by sharing the same knowledge and specializations. Region in this case is defined as a related area which industries correlate and having spillover effects.

Porter (2003) suggests that, regional economic performance is strongly affected by companies and institutions that generate innovations by the strengths of clusters and the vitality and plurality output, and regional performance differences are dominated by relative wage levels in the array of clusters that are present in a region, rather than the particular mix of clusters itself. Therefore, wage in the observations is an important factor to be measured by comparing to different locations, especially to the adjacencies to derive the spillovers. This research displays spillover effects from dominate clusters to supportive or correlated clusters on the properties of employment, revenue or wage growth rates. The spillover adjacency locations form the higher-end knowledge based clusters which has the effects to the wage growth.

4.7. Location

Location matters especially when it comes to spillover of knowledge, manpower pools, and even markets (Porter & Stern, 2001). In proposing a new theory of economic geography, Paul Krugman (Krugman, 1990, p. 55), asks, “What is the most striking feature of the geography of economic activity? The short answer is surely concentration...production is remarkably concentrated in space.” provided evidence that what Krugman observed to be true for production was even more pronounced for innovative activity (Audretsch & Feldman, 2004; Feldman & Florida, 1994). By the nature of industry such as Information and Technology which is high in knowledge innovation displays the concentration and agglomeration properties in Taiwan. The economic cluster agglomeration research has evolved from Cluster Definitions,

Microeconomic of Competitiveness (MOC) framework, Cluster Initiatives, and to Cluster Organizations. Taiwan is in the initial stage of mapping the cluster definitions for policy makers and practitioners. Although following the US cluster definitions is a safe first step since the US have a large population and an open market with various industries linking to Taiwan's products and services output, Taiwan needs its own cluster mapping due to the geo-economic differences. The sharing of the cluster definitions provides a synchronized backdrop for data comparisons.

4.8. Productivity – wage importance

Wage and competitiveness in labor productivity are more controversial and less understood. Porter claims that "Productivity and innovation – not low wages, low taxes, or a devalued currency – [that] are the definition of competitiveness" (Porter, 2003). Although wage is not a driver, but it is a measurement for the employment demands. Porter links innovation and competitiveness in that innovation is a significant driver of productivity. The manpower required for innovation normally requires more training and higher wages. The earlier research is short of these types of analysis, linking the wage to productivity. James Simmie in the book criticized the link between innovation and productivity and thence to competitiveness is complex and not particularly well understood (Simmie, 2006, p. 166). In his chapter, he quoted by Martin and Sunley (Martin & Sunley, 2003) stating that "both the geographic and the industrial definitions of clusters in Porter's work are ridiculously elastic…there is nothing inherent in the concept itself that provides a way of defining the spatial range of a cluster or which are the key dynamic processes a different geographical scales…it is very difficult to investigate the dynamics of clustering starting from a spatial definition. (Simmie, 2006, p. 168)" Michael Steiner (Steiner, 2006, p. 199) also quoted Martin and Sunley (Martin & Sunley, 2003). Despite all the criticisms at the time of 2006 after a decade of framework being released by Porter, Porter's (Porter, 2011) discussion of clusters has been very influential in shaping policy for competitiveness and innovation (Swann, 2006, p. 255). Putting wage growth as an evaluation factor will further strengthen cluster research which may reflect the contextual influence of wages and employment by the labor pool availability (both quality and quantity) in relations to the industrial demands. Taiwan's

wage weights differently from north to south, and the spillover effect confirm the wage importance in relations to the knowledge-based industries.

4.9. Cluster Initiatives

Time has come by that Porter's work has extended the research on cluster and cluster initiatives in a much rigorous theoretically and empirically with the recent releases (Delgado, Bryden, et al., 2015; Delgado et al., 2014; Delgado, Porter, & Stern, 2015; Ketels, 2011; Porter, 2008; Porter, 2011; Porter et al., 2007). Cluster appears to be attractive with Porter's earlier vague framework which might have been too broad and too grand that there has been a continuous effort till today to demonstrate an interactive cluster mapping funded by the US Commerce Department, Economic Division, for four years to create a quick assessment of all industrial maps on all cities, districts, states, and specialties for policy maker to monitor the dynamic changes of the US economic status. This adds credence to his earlier work of the national analysis on the U.S. (Porter, 2011) and builds a foundation for the later cluster research.

Twenty four years have gone by since then, and the first look of the cluster map is just fully done[12]. It is a long road for the research and development, and the concept are just matured with technology that criticism might have been the fuel to empower the grand theoretical framework to start to show its impacts. Of course, there are followers and researchers who divide the framework into "Cluster formation in these cases had dual purpose: to solve unemployment and other local social and economic problems and secondly to derive a competitive advantage (Porter, 1990b)." quoted by Maryann Feldman and Johanna Francis (Feldman & Francis, 2006, p. 119) who also identifies entrepreneurs are cluster shapers. The evolution is often created with entrepreneurs as the Silicon Valley success demonstrates. More topics have been researched concerning cluster initiatives, organizations, topology, top-down and bottom up cluster models, social network influence and social openness (Eisingerich, Bell, & Tracey, 2010; Fromhold-Eisebith & Eisebith, 2005; He & Fallah, 2011; Jungwirth & Müller, 2014), and the extension of the research has proven the strong relations between clusters and

[12] The US cluster mapping was formally released in September, 2014 in Minneapolis.

agglomeration. In the US cluster mapping, wages are measured across the regions and with all specializations. It identifies the higher pay jobs versus the lower ones. It is evidential by the European cluster initiatives that they are the stimulus for the economic development (Solvell & Lindqvist, 2015). By setting up Taiwan's cluster mapping is setting up the foundation for cluster initiatives for the future.

4.10. Defining Regions

A region is defined to be a geographic area where businesses share resources and exchanges. It does not have to be the political drawn boundaries. It is a populated area with similar business exchanges shares labor pools. A region can be a city, county, state, economic area, nation, national union (e.g. EU, ASEAN). Marshall (Marshall, 1920) highlighted three distinct drivers of agglomeration: input-output linkages, labor market pooling, and knowledge spillovers, which are associated with cost or productivity advantages to firms. The new cluster linkage method identifies clusters that define regional comparable clusters (Delgado et al., 2014), and the industries that constitute a cluster are the same for all regions. Inter-industry linkages are identified through the co-location patterns of industries across regions, or with a range of national data available across industries. The identified linkages are used to group industries into a set of defined clusters, allowing clusters to be compared across regions.

Porter's research group generated a set of cluster definitions to regroup the current industry code from NAICS. In the NAICS, similar to Taiwan's industrial code that contains the firms' data in a city level. Through their work of comparison with other cluster definition methods, the result shows the new definition is a superior set (Delgado, Porter, et al., 2015). Although the analysis is done with the US data, the US industries are large enough to attain varieties and quantities in a freely traded economy that has large enough sample to test all the industries.

A small economy like Taiwan may be specialized deeply in a few clusters and in depth with spillover effects to a narrow range of industries. In fact, the research confirms this effect for Taiwan with statistic correlation and K-mean cluster method on three sets of growth rates. It is evidential that the cluster agglomeration with the spillover effect which

may bring growth, but they behave differently on wage and employment growth factors; thus, it is very important to understand how clusters diversify and grow in a region. Specially, the region in this research can be defined in city level or district level whenever is applied, and when the cluster factors are drawn upon a region, it displays the economic landscape of the region.

4.11. Diamond Analysis

Cluster initiatives take the understanding of economic landscape of a region and detail analysis of demands from various factors in order to make the initiative realistic and complete. Porter's Diamond analysis can provide the analytical framework to examine the cluster map to determine from four dimensions, factor conditions, demand conditions, firm strategy structure and rivalry, and related and supporting industries (Porter, 2008). Therefore, a cluster analysis goes beyond one industry, involving many related industries and clusters to determine its growth potentials and weaknesses. The infrastructure designed by Porter with Diamond analysis is an economic analytical architect what the cluster mapping is a foundational framework, and the Diamond analysis designs the interior which makes the building functional and sustainable.

An empirical case research had been conducted in 2015 on Taiwan's Machine Tool Industry (Tan et al., 2015) research demonstrating the application of successful findings and recommendations utilizing the cluster analysis. Another similar research conducted in 2015 on cosmetic facial product being matched with a textile production area using the cluster framework confirms the usefulness of such methodology (Chen, 2015). This is also a reason why the new cluster linkage analytical development is important, which supports the needed cluster extension to better determine the potential for policy setting or spillover's growths. Cluster research and reports can be useful to practitioners in finding the needed resources as well as the business strategies. Another example the cluster analysis report is instrumental for policy makers to allocate resources, decide policies upon the recommendation from the report, and a research report on New York Apparel Cluster (Collier, Fruscio, Lee, & Tan, 2015) was recommended by Professor Porter to New York City Mayor and its staff for their policy recommendations. The

Diamond analysis is not demonstrated in this dissertation but is in the literature disclosed above.

4.12. The Demand for Uniting Policy Makers and Practitioners in Asia

As the process of globalization moves fast forward. There is an increasing need for cluster-based data to support research, facilitate comparisons of clusters across regions, and support policymakers and practitioners in defining regional strategies (Delgado et al., 2014). Most Asian countries, including Taiwan, have been left out of cluster mapping research while enjoying the double digit manufacturing growth with the low labor cost. Even there were sporadic research but remains scholarly without the collaborative initiatives with practitioners and policy makers (Chen, 2014; Tan et al., 2015; Tsai, Lin, Chu, & Perng, 2009). There is a strong demand in Taiwan to bridge the gap between policy makers and practitioners (Yu et al., 2011). Now that the heat is over with a saturation of production growths, and wages have been risen, it is time to consider a better strategy than pricing competition.

Porter's theory states pricing is not a strategy, at least not for long term. The low cost production has again been transferred to other lower wage countries, such as Vietnam or Cambodia. In this scenario, wage definitely is an influencing factor for a region's productivity and economic growths, and in the later section, the relations will be more closely defined. The lower wage regions can attract production orders and improving revenue and employment growths, which mean many developing countries grow and raise their GDPs. Most parts of Northeast Asia have gone through this process earlier, especially Taiwan and China which focused primarily on OEM manufacturing. Now that they are both searching for the next strategy to expand. This is a critical issue for parts of Taiwan that wages are low for some clusters. Evidently, Taiwan is no longer competitive in low labor cost; thus, tighten up the communication between policy makers and practitioners to create cluster initiative to overcome the low wage issues is the most urgent task for Taiwan.

4.13. A Versatile Tool for Effective Cluster Initiatives

Cluster initiatives are the natural extension of cluster mapping projects. Every industry in every location is different from their local factors and demands; therefore, the cluster mapping methodology, developed by Porter and extended scholars worldwide, is a valuable tool for researchers, practitioners, and policy makers to use to map out locations' specializations and build a healthier business environment for their industries' sustainability. As an example, the US Cluster Mapping platform was formally announced by the US Secretary of Commerce after a four-year project directed by Porter in September 2014. The preparation and the economic initiative announced by the policy makers are important for the US economic recovery and the US productivity.

"In June of 2014, U.S. Commerce Secretary Penny Pritzker announced the launch of the U.S. Cluster Mapping and Registry project, a national economic initiative based at Harvard Business School's Institute for Strategy and Competitiveness and supported by the U.S. Economic Development Administration. The U.S. Cluster Mapping and Registry project aims to strengthen U.S. competitiveness by understanding the economic performance of clusters and regions across the United States[13]." -- Release from the U.S. Commerce News.

The project US Clusters Mapping, developed by the Institute for Strategy and Competitiveness at Harvard Business School headed by Porter, has been granted by the U.S. Commerce Department Economic Development Administration (EDA) in 2009, in response to the world financial crisis and the rise of unemployment rate in the US, to promote economic growth and national competitiveness. Many local cluster initiatives are created as a result of the Cluster Mapping Project implementation. "The U.S. Cluster Mapping Project is used by governments, economic developers, and businesses to understand and shape the competitive landscape for a wide range of industries." by the U.S. Secretary of Commerce Penny Pritzker on July 14, 2014[14]. The U.S. has set a policy to treat regional economies as the building blocks of U.S. competitiveness, and aimed to

[13] https://www.commerce.gov/news/blog/2014/06/data-driving-development-eda-releases-new-cluster-mapping-tool-help-spur-regional
[14] http://www.clustermapping.us/about

connect businesses with cluster initiatives to promote economic development, policy and innovation. The cluster mapping development utilizes big open economic data from many years to trace and track the growth rates and various indicators.

After four years of research and preparation, the US are ready for economic rebuild through cluster initiatives and entrepreneurship from communities in all states. According to its new release, the US EDA received many inquiries for grant information on regional cluster initiatives. U.S. communities are working on cluster initiatives to spur economic growth and create jobs. The cluster mapping website provides a dynamic view of US regional industrial statistics which utilizes big open data from various databanks including IMF, the World Bank, UN Comtrade, the International Trade Center of United Nations (ITC), International Labor Organization (IOL), and the US Central Intelligent Agency (CIA). With these many data sets and different formats, normalization has become an issue thus becomes a big data manipulation problem. The latest trend has been moving to visual display of big data for the ease of understanding. Making data easily accessible and meaningful is literately every databank's project. For that, designing a common interface to deal with the data legacy issue is a must, and the interface to be useful and flexible to adapt for quick changes is another challenge.

Cluster mapping is not unique in the US; EU also has cluster observatory to serve the publics for industrial mapping. A flexible tool on a cluster mapping platform that can be quickly understood by business people and policy makers makes it easier for assessment and planning; thus, graphical presentation is crucial for quick reading and easy digestions. This is very similar to the earlier instrumentation designs that computer and equipment cannot communicate without a common interface, and the data stored in the computer system without a structure is not useful. The cluster mapping project basically created a common interface for everyone's use, and it can be easily understood and flexible to adapt to the world dynamics. Finally, the US Cluster Mapping tool is designed as a source of information for entrepreneurs to initiate their own projects based on the latest informative knowledge and resource allocation. The government is there to support the initiative with needed resources. Similarly, for this dissertation, a 3-D Dynamic Tool

is developed for the ease of use of Taiwan's clusters' display for public users including practitioners, researchers, and policy makers.

5. Methodology and Framework

This research is a mix model of quantitative and qualitative studies. Both methodologies are described in the next sections.

5.1. Qualitative Analysis

A comparative analysis is done on different models of policy decision flows. Some policies, although well intended, can become bottlenecks for economic progress, and some can support industrial infrastructural improvements. A good set of policies must echo the industrial demands to support the business infrastructure and its environment, and how policy makers making their decisions is a crucial factor to the success in delivering effective policies. Therefore, Taiwan's policy decision flow is compared with the European and US policy decision flows to identify how other governments utilizing different models to promote cluster initiatives to meet the industrial demands. The purpose is to unite policy makers and practitioners to make effective initiatives for the economic growths, and it can help business practitioners to identify their strategies when dealing with competition in a global economy and external shocks, and policy makers to set their economic development policies in accordance to industrial growth and potentials.

5.2. Quantitative Analyses

This dissertation utilizes a cluster-mapping framework to identify the changes of an economic shift to draw conclusion on Taiwan's economic landscape and dynamics. The framework is set for data-driven quantitative calculations, and the research primarily focuses on the dynamics during an external shock period and draws the landscape based on the growth factors. The goal is to derive a foundation for the research to provide a fast and clear view of Taiwan's clusters' growths and declines for the future analyses such as policy recommendations and business strategies

5.2.1. Data

Two sets of census data, 2006 and 2011 Taiwan's Industry and Business, were retrieved from the Taiwan National Statistics Bureau, and both sets of data were transformed into the corresponding US Cluster Definitions to form the Taiwan Cluster Definitions. The extracted data of employment, revenue, compensation are used to calculate employment, revenue, average wages' growth rates, and specialization to determine the dynamics of 5 years' economic shift from 2006 to 2010. The cluster definitions for Taiwan has been defined in the early process of the research with Porter's researchers by correlating the cluster codes closely[15]. (See Appendix - The US Clusters Code Definitions and Appendix - Taiwan Clusters Code Definitions) A cluster map is created based on every city and for every cluster. The smallest region is defined to be on city level. A matrix of 135 by 45 data maps is created for each set of census raw data. This is the actual collected enterprises' data, thus, will provide close to accurate estimates. The detail procedure for data preparation is listed in Appendix - Data Preparation. Furthermore, growth correlations are made among the growth rates of industry clusters with all cities to derive Taiwan's economic landscape. The unit of analysis for this research is industry clusters, and the variables are growth rates (revenue, employment, wages) to reflect the dynamics. Assuming innovation is high across the board; the innovation ranks high (top 4) for Taiwan according to the US patents statistics (Figure 27), therefore, is not in the subject of analysis.

5.2.2. Taiwan's Districts

Taiwan's cities are regrouped into 7 industrial districts. Taiwan's cities are the first set of regions and tested for correlations since that is how census data grouped. The cluster maps then demonstrate the specialty landscape with the adjacent cities. Those similarly adjacent cities were combined into a broader region (defines district). All the cities are regrouped into 7 districts by its geographic adjacencies with similar cluster landscapes. This coincidentally matches the local people's customary divisions, also a part of natural

[15] This project is with Professor Porter's endorsement and the help from by the data manager of Institute for Strategy and Competitiveness, Richard Bryden to define Taiwan's Cluster Definitions.

division. The national data are divided based on political boundaries of city which may not necessarily reflect the economic boundaries.

From 2011 Taiwan's Census data, 5 regions were collected from the National Statistics Bureau and are listed below:

North Region – Taipei City, Taipei County, Keelung, Hsinchu City, Hsinchu County, Taoyuan County, Yilan County

Middle Region – Taichung City, Miaoli County, Changhua County, Yunlin County, Nantou County

South Region – Chiayi City, Chiayi County, Tainan City, Kaohsiung City, Pingtung County, Penghu County

East Region – Taitung County, Hualien County

Outer Islands – Kinmen County, Lienchiang County

After an evaluation based on the cluster landscape, 7 regions are identified and regrouped, and they are:

North Region – Taipei City, Taipei County, Keelung

Northwest Region – Taoyuan City, Hsinchu City, Hsinchu County, Miaoli County

Middle Region – Taichung City, Changhua County, Nantou County

Southwest Region – Yunlin County, Chiayi City, Chiayi County, Tainan City

South Region - Kaohsiung City, Pingtung County

East Region – Yilan County, Taitung County, Hualien County

Outer Islands – Penghu County, Kinmen County, Lienchiang County

5.2.3. Analytical Framework

With this said, this creates a big learning step for the research not to re-invent the wheel but to adopt to the methodology of user friendly interface. The newly defined US cluster

definitions is the first lesson to learn.[16] The Appendix - Data Preparation is dedicated to describe the first step of the process of this adaptation to normalize Taiwan statistical data retrieved from the Taiwan National Statistics Bureau. After the data is cleaned and prepared in the growth format, regional data are plotted for analyses. Each city is analyzed with clusters' growths, and each cluster is analyzed with cities' growths. From the city cluster map, dominated and strong clusters are identified by the growth analysis. A dominated cluster has large shares in both cluster and location workforce. For example, Hsinchu has over 50% local workforce working in the IT cluster, and an over 10% of total IT populations working in the Hsinchu. A strong cluster is identified by 5% of total cluster populations in the region, not as intense as the dominated cluster of 10%. The strong clusters tend to grow in a group since many strong clusters have stickiness as a value-chain. More detail analyses will be provided to demonstrate these properties in X Cluster Analyses.

5.2.4. Clusters' Dynamics with the Desired Presentations

The study of clusters is important to reflect the dynamics of industrial agglomerations either by spillovers or supply-chain expansion. The three calculated growth rates are plotted on 3-Dimentional bubble maps to present the dynamics of clusters in the regions. International businesses and trades have been going on for centuries, and not until recently the open information act has made competition open on an equal base. The hidden advantage is disappearing due to fast communication and open media, in which limited goods were offered with a price paid, and now goods are in high demanded. The market has become consumer demand driven versus supply driven. Customers are no longer just being provided with the goods and services locally. People are buying and receiving goods all over the world and delivered within days. Data and information of all sorts have also been demanded, so that varieties can be found for a bigger and better consumption. Thus, this makes market behavior directly linking to the industries' growths with high dynamics. The world transportation and logistics have been operating

[16] Categorization of Traded and Local Industries in the US Economy, Mercedes Delgado Richard Bryden Samantha Zyontz; and other articles in US cluster mapping website in cluster definition section. See US Cluster Mapping website for detail definition.

24 and 7 to meet the delivery demands. Studies on cluster shift can show how market is moving and help to create strategies to meet the demanding markets. The circulatory business cycle (Schumpeter, 1939) has shortened its duration and created high dynamics.

Size matters for a particular cluster in a region. The shares of clusters are calculated for the importance of labor productivity. A dominated cluster over 10% workforce nationally has a bigger influence to the GDP. A weak and large cluster can be dangerous for a nation. On the other hand, a small cluster that is growing fast can be potentially agglomerated into a large cluster provided the stimulus is high and suitable for the growths. Therefore, growth rates are important to be measured along with the cluster share sizes. Cluster shares nationally over 5% overalls can be important enough for the cluster. It carries enough weight to become a nationally important cluster. Hence, smaller but potentially fast growing clusters can be the future stars if policy and resources are put into the right demand. Therefore, examining the growth rates and the shares are the first indications to look for in terms of specialization.

5.2.5. Details of Growth Analysis

For the dynamics of clusters, employment, revenue, and wages' growth rates of each region will be calculated to see the shifts after the external shock among all clusters. Some clusters grew and some declined. Equally, some regions are growing and some regions are declining. The momentum provides reviewers with indications to search for issues. Along with each cluster size and shares within a region, different categorization may carry different implications. Below is a chart (Figure 2) describing the possible momentums. The last row includes the specializations that are nationally important. These are the factors when reviewing the growth maps for the understanding of the dynamics. It provides a direction what to look for the next, especially for the microeconomic analysis. Since employment has the strongest social impact, the employment growth is evaluated first. See below guideline.

Figure 2 Cluster Shares and Growth Analysis Guideline.

Cluster Employment Regional Shares	Declining	Stagnate or slow growth	Fast growth
Small shares < 5%	Little impact to the regional employment	No significance	An indication of potential, but not influential yet
5% to 10% regional shares	With regional employment impact	A stable regional cluster.	With good regional impact and potentially a national importance.
>10% regional Shares	Very important regional impact and needs to find out the reason of the decline.	This may be a saturation point.	2 possibilities: very isolated region with a small population. Large metropolitan and a high potential to be nationally important.
>5% regional shares and nationally important clusters	This is national important and needs a good policy and strategy to recover the cluster vitality. Maybe industry upgrades or technology innovations needed.	This cluster is reaching a stagnation but may need innovation for upgrades and expansion.	This is a high potentially growing clusters which has more room for growth; skill training and innovations are important for the growth.

5.2.6. Location Quotient – Specialization Calculation

Location Quotient represents the concentration of a certain cluster in a location in reference to the national ratio. If the ratio is over 1 meaning the regional cluster has the national importance. The higher the number, the more concentration of the cluster in the national importance, and it is a highly specialized cluster with the national importance. Industry LQs are calculated by comparing the industry's shares of regional cluster factor

with its shares of national cluster factor, and the factor can be employment, revenue, or wages.

Figure 3 Location Quotient Equation.

$$LQ = (\frac{X}{Y})/(\frac{X'}{Y'})$$

LQ = a ratio of a local cluster factor shares to the national cluster factor shares.

X = local factor counts of a cluster of a region

Y= total regional factor counts of a region

X' = total factor counts of a cluster of a nation

Y' = total national factor counts of a nation

For example: Revenue Location Quotient of the Business Services Cluster in Taipei is calculated:

Figure 4 Revenue LQ Equation.

$$Revenue\ LQ = (\frac{Revenue\ of\ Business\ Services\ cluster\ in\ Taipei}{Total\ Revenue\ of\ Taipei}) /(\frac{Revenue\ \ of\ Business\ Services\ cluster\ in\ Taiwan}{Total\ Revenue\ of\ Taiwan})$$

Below are the implications for LQ and employment shares:

Figure 5 Cluster Shares and LQ conditions.

Employment Shares\LQ	LQ<1	LQ>=1	LQ>=2

Regional Shares <=5%	No significance	Regional specialty and national important, can be with in a large population or a very small cluster nationally	Very concentrated specialty in the region
5% < Regional Shares<10%	Regional specialty	Region specialty and national important	Regional and national specialty
Regional Shares >=10%	Regional concentrated specialty but not nationally important. This can be in a small region	Highly concentrated regional and national specialty	Dominated and highly concentrated regional and national specialty

The research will find out where the specialty concentrations are among all redefined clusters for Taiwan, and the cluster map may be evaluated based on the above implications.

5.3. Statistic Correlations

All clusters and all cities' data have been tested using Pearson correlation. The statistics correlations confirm that Taiwan Traded clusters' growth rates are highly correlated. The result shows the high correlation on all three growth rates across the board over all cities on traded clusters with exception of the Outer Islands. Additionally, by running the larger redefined district-region correlations which also confirm the correlation. Followed by running K-mean cluster prediction. The result shows there is only one cluster in Taiwan. The initial correlation started with 6 clusters' definitions, and it remerged into one after several runs. That means Taiwan has only one dominated industry. The statistical correlations cannot tell in precision which city has which industries actively growing or declining on what factors. In order to find out the answer, a scoring system is developed to identify the dynamics of the clusters in a region.

Cluster Scoring Method

A scoring system is developed to identify Taiwan's regional economic landscape, and specializations, shares, and growth rates are analyzed. The system evaluates on four important factors, location quotient (LQ), employment shares, employment growth rates, revenue growth rates, and wages growth rates. Correlation has been done to confirm the all three growth rates are highly correlated in the Traded Clusters of all Taiwan cities and regions, and very little correlation among the Local clusters' growth rates. Therefore, only the Traded cluster growth rates are used for the ranking system.

The scoring system includes the following:

Location Quotient: LQ represents the concentration of a cluster in a region. It gives the indication that the regional cluster correlates with the national ratio. A ratio of 1 meaning the region has the same concentration of the national ratios. LQ over 1 means the concentration is higher than the normal national and is an important location, and LQ over 2 means the cluster is highly specialized in this region.

Employment Shares: any cluster over 5% shares has important presence in the region. It carries a good weight in employment participation.

Employment Growth Rate: The growth rate indicates whether the cluster is actively growing and hiring.

Revenue Growth Rate: The revenue growth indicates the market demand for the cluster. More revenue normally means more work. Of course there may be other factors influencing the revenue rise. Technology breakthrough with a better production efficiency can also raise more demand such as machine automation with a faster throughput can give more capacity on production and receive more orders.

Wage Growth Rate: The wage is an important gauge for the sustainability of the workforce. The higher the wages, normally indicates the work skills and knowledge may be high, or there might be more workflow from the businesses. It can also imply that there is a shortage in labor pool.

A scoring system is designed for easy reading of cluster's characteristics. The scoring system is digitally sliced numerical groups by every three digits to read out the sum of each group for the accumulation of the group counts. Below are the detail definitions of the group representations.

Figure 6 Cluster ID Scoring Digit-Sliced Evaluation System DSE.

Factors	Conditions	Assigned Value	Note
LQ	LQ>=2	100,000,000,000,000	Highly specialized cluster and concentrated in a region
LQ	2<= LQ >=1	100,000,000,000	Specialized cluster in national standard
Employment Shares (ES)	ES>=n%	100,000,000	The cluster has a significant presence in a region. N is normally a 5 to find strong clusters.
Employment Growth Rate	Compound Annual Growth Rate (CAGR)is calculate based on employment counts.	100,000	Employment represents workforce participation. Positive numbers n means there are n clusters growing. The higher n is the more clusters have employment growth.
Revenue Growth Rate	CAGR is calculated based on revenue.	100	Revenue growth means better income for the businesses in general. The number represents numbers of clusters in growth.
Wage Growth Rate	CAGR is calculated based on the average wages of a cluster.	1	Wage growth indicates a sustainable workforce and sustainable businesses. Wage drop can mean oversupply. Number represents the number of clusters have wage rising.

This Score Card will be applied in the analysis of Taiwan cluster evaluations in the Regional Analyses.

5.4. Types of Clusters – Analyzing the Growth:

In Figure 7, ES (employment shares),we see that New Taipei has 2 clusters over 10% employment shares. Other cities have 1 cluster are the cities with a higher concentration of one dominate cluster such as IT for Hsinchu City, or the area with less population. The zero indication means there is no one cluster dominates the city. When LQ is =1, this means the regional employment ratio if equal to the national ratio to other clusters. But when LQ >2, it means the ratio is twice as much as the national ratio. The right-hand 3 groups are the accumulations of positive growth rates (EG=employment growth, RG=Revenue Growth, WG= wage growth).

Figure 7 Cities' Cluster ID Scores.

Cluster ID Score	total 2LQ,1LQ,ES,EG,RG,WG *	traded 2LQ,1LQ,ES,EG,RG,WG *	local 2LQ,1LQ,ES,EG,RG,WG *
New Taipei	2,019,002,031,043,030	2,015,002,022,034,020	4,000,009,009,008
Taipei	7,014,001,032,042,040	5,007,001,024,032,030	2,007,000,008,010,010
Taichung City	6,017,000,040,047,040	6,011,000,030,035,030	6,000,010,012,012
Tainan City	8,021,000,035,039,030	8,014,000,024,029,020	7,000,011,010,008
Kaohsiung City	3,020,001,035,041,030	2,011,000,024,029,020	1,009,001,011,012,010
Yilan County	11,014,002,032,039,000	10,004,001,024,029,000	1,010,001,008,010,000
Taoyuan City	4,012,001,042,043,030	4,011,001,029,031,030	1,000,013,012,009
Hsinchu County	5,009,001,042,039,030	5,007,001,031,030,020	2,000,011,009,007
Miaoli County	7,010,001,035,040,020	7,007,001,024,030,020	3,000,011,010,005
Changhua County	14,009,000,039,043,000	14,005,000,028,032,000	4,000,011,011,008
Nantou County	9,016,000,033,035,020	8,007,000,024,028,020	1,009,000,009,007,000
Yunlin County	7,022,000,038,040,030	7,012,000,026,030,020	10,000,012,010,005
Chiayi County	9,019,000,038,040,020	9,013,000,027,030,020	6,000,011,010,008
Pingtung County	10,015,002,038,042,000	7,008,000,029,032,030	3,007,002,009,010,010
Taitung County	10,006,002,021,027,000	5,001,000,014,021,010	5,005,002,007,006,010
Hualien County	8,010,003,033,036,020	4,002,001,024,026,020	4,008,002,009,010,010
Penghu County	8,010,002,030,022,010	4,001,001,017,015,000	4,009,001,013,007,010
Keelung City	4,017,002,033,038,030	3,008,001,023,029,020	1,009,001,010,009,010
Hsinchu City	2,003,001,033,035,030	2,002,001,020,025,030	1,000,013,010,006
Chiayi City	6,010,001,028,038,020	3,004,000,020,029,020	3,006,001,008,009,010
Kinmen County	8,012,003,034,033,020	6,004,002,022,022,020	2,008,001,012,011,000
Lienchiang County	6,006,003,012,017,010	4,002,002,007,007,010	2,004,001,005,010,010

** Employment Shares >=10% for the boundary*

2LQ=location quotient is 2; LQ=location quotient is 1; ES=cluster employment shares; EG=# of clusters with employment growth; RG=# of clusters with revenue growth; WG=# of clusters with wage growth

5.4.1. Dominated Clusters

With the 10% dominated clusters' tests, the ES digit group shows the numbers of dominated cluster in one city. From Figure 7, and New Taipei, Kinmen, and Lienchiang have two dominated clusters; 9 cities have one dominated cluster. Distribution and Electronic Commerce dominates in New Taipei and Taipei. Distribution and Electronic Commerce dominates in New Taipei, Taoyuan, Hsinchu City and County, and Miaoli. Construction Products and Services dominates in Yilan, Hualien, Penghu, Kinmen, and Lienchiang. Food Processing and Manufacturing dominates in Kinmen. Water transportation dominates in Keelung and Lienchiang. Other cities do not have dominated clusters.

5.4.2. Highly Specialized Clusters

Next we are interested in finding out which city has certain highly specialized clusters. This is by looking at the 2LQ digit group of the DSE Score. Changhua has the most (14) highly specialized clusters, and New Taipei, Kaohsiung, and Hsinchu city have the least (2) highly specialized clusters. It is interesting that Changhau does not have a dominated cluster, but clusters are very specialized. Conversely, New Taipei and Hsinchu City with highly dominated clusters has the least highly specialized clusters. We can conclude that a city with dominated clusters with an employment mass over 10%, the specialized clusters are reduced to the minimum. The dominated clusters have high growth momentum, which attracts labor pool to converge. This also differentiates two types of cluster agglomeration. One is the dominated cluster type, and the other is the specialization cluster type. We will later evaluate New Taipei and Hsinchu for the dominated clusters, and Changhua for the specialization type by how each dynamic behave. First let's understand the growth rates by taking the next cluster size from 5% shares and up and interpret the indicators below.

Figure 8 Digit Sliced Evaluation System.

Cluster ID Score	Total 2LQ,1LQ,ES,EG,RG,WG *	Traded 2LQ,1LQ,ES,EG,RG,WG *	Local 2LQ,1LQ,ES,EG,RG,WG *
NewTaipei	2,019,003,031,043,030	2,015,002,022,034,020	4,001,009,009,008
Taipei	7,014,007,032,042,040	5,007,003,024,032,030	2,007,004,008,010,010
TaichungCity	6,017,005,040,047,040	6,011,003,030,035,030	6,002,010,012,012
TainanCity	8,021,005,035,039,030	8,014,002,024,029,020	7,003,011,010,008
KaohsiungCity	3,020,005,035,041,030	2,011,002,024,029,020	1,009,003,011,012,010
YilanCounty	11,014,005,032,039,000	10,004,001,024,029,000	1,010,004,008,010,000
TaoyuanCity	4,012,003,042,043,030	4,011,002,029,031,030	1,001,013,012,009
HsinchuCounty	5,009,003,042,039,030	5,007,002,031,030,020	2,001,011,009,007
MiaoliCounty	7,010,003,035,040,020	7,007,001,024,030,020	3,002,011,010,005
ChanghuaCounty	14,009,006,039,043,000	14,005,004,028,032,000	4,002,011,011,008
NantouCounty	9,016,007,033,035,020	8,007,003,024,028,020	1,009,004,009,007,000
YunlinCounty	7,022,006,038,040,030	7,012,003,026,030,020	10,003,012,010,005
ChiayiCounty	9,019,006,038,040,020	9,013,003,027,030,020	6,003,011,010,008
PingtungCounty	10,015,006,038,042,000	7,008,002,029,032,030	3,007,004,009,010,010
TaitungCounty	10,006,006,021,027,000	5,001,002,014,021,010	5,005,004,007,006,010
HualienCounty	8,010,007,033,036,020	4,002,003,024,026,020	4,008,004,009,010,010
PenghuCounty	8,010,007,030,022,010	4,001,003,017,015,000	4,009,004,013,007,010
KeelungCity	4,017,007,033,038,030	3,008,003,023,029,020	1,009,004,010,009,010
HsinchuCity	2,003,002,033,035,030	2,002,001,020,025,030	1,001,013,010,006
ChiayiCity	6,010,005,028,038,020	3,004,001,020,029,020	3,006,004,008,009,010
KinmenCounty	8,012,007,034,033,020	6,004,003,022,022,020	2,008,004,012,011,000
LienchiangCounty	6,006,007,012,017,010	4,002,004,007,007,010	2,004,003,005,010,010
total size	5,040,051,042	3,028,039,031	2,012,012,011

**Employment shares >=5*

5.4.3. Strong Clusters

The strong cluster is defined: When a cluster with local specialization agglomerates, the cluster starts to converge with the employment growth, and if the market demand continues to be strong, it will become a strong cluster. The strong cluster will further agglomerate into a dominated cluster with concentration and high growing market demand with innovations and a highly skilled labor pool. As long as the market demand remains strong, the specialization continues to evolve and deepen, and the growing labor participation start to dominate the region. The strong clusters are defined to be with large

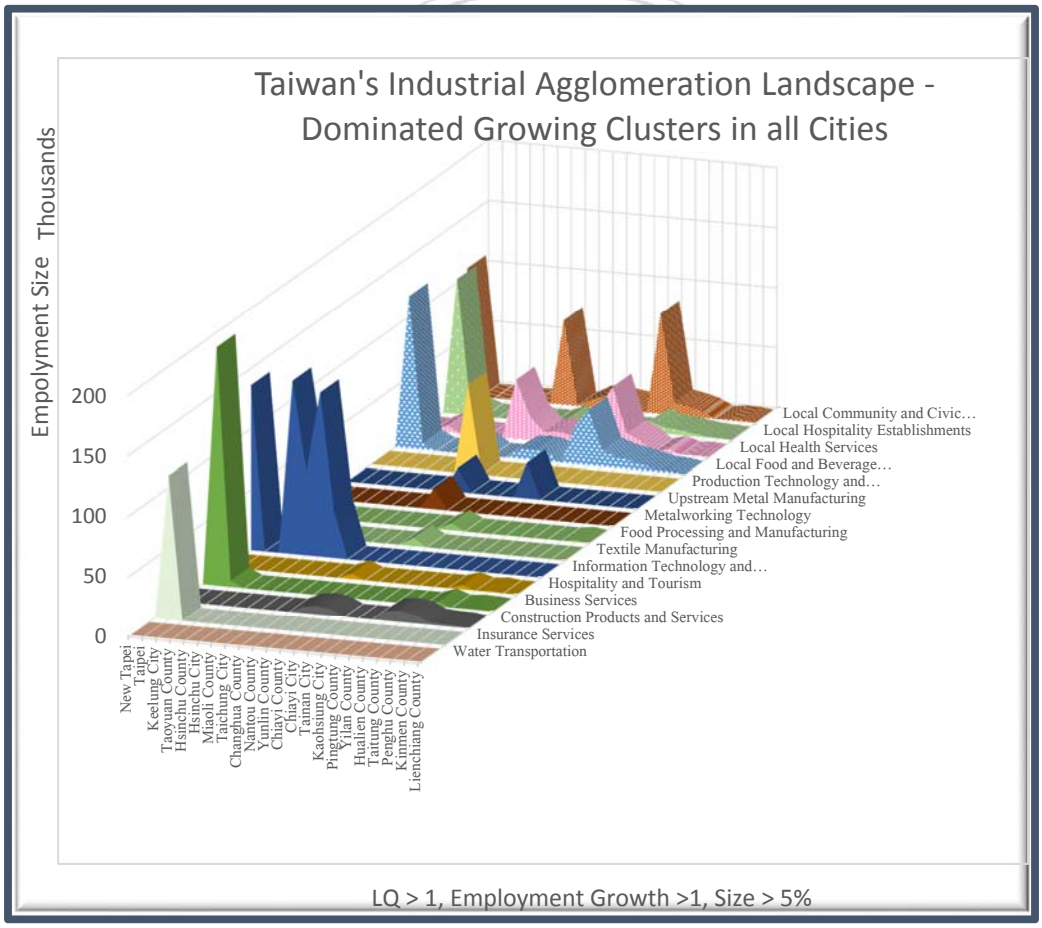
shares of labor participation with a high concertation of specialization. A dominated cluster is also the strongest cluster. In this case, active strong clusters are defined to be specialized clusters (LQ) that have employment shares (MS) over 5% of regional employments and growing (EG), and the formula is as below:

Figure 9 Strong Cluster Definition with Specialization and Growth Rate Qualification.

$$(f) = LD > 1 \; and \; ES > 5\% \; and \; EG > 0$$

Taiwan's strong clusters' landscape are mapped below.

Figure 10 Taiwan's Industrial Agglomeration – Strong Clusters in all Cities.



Source: *Taiwan National Statistics Bureau*

Below are the detail active strong clusters in Traded and Local clusters:

Figure 11 Active Strong Clusters in All Cities.

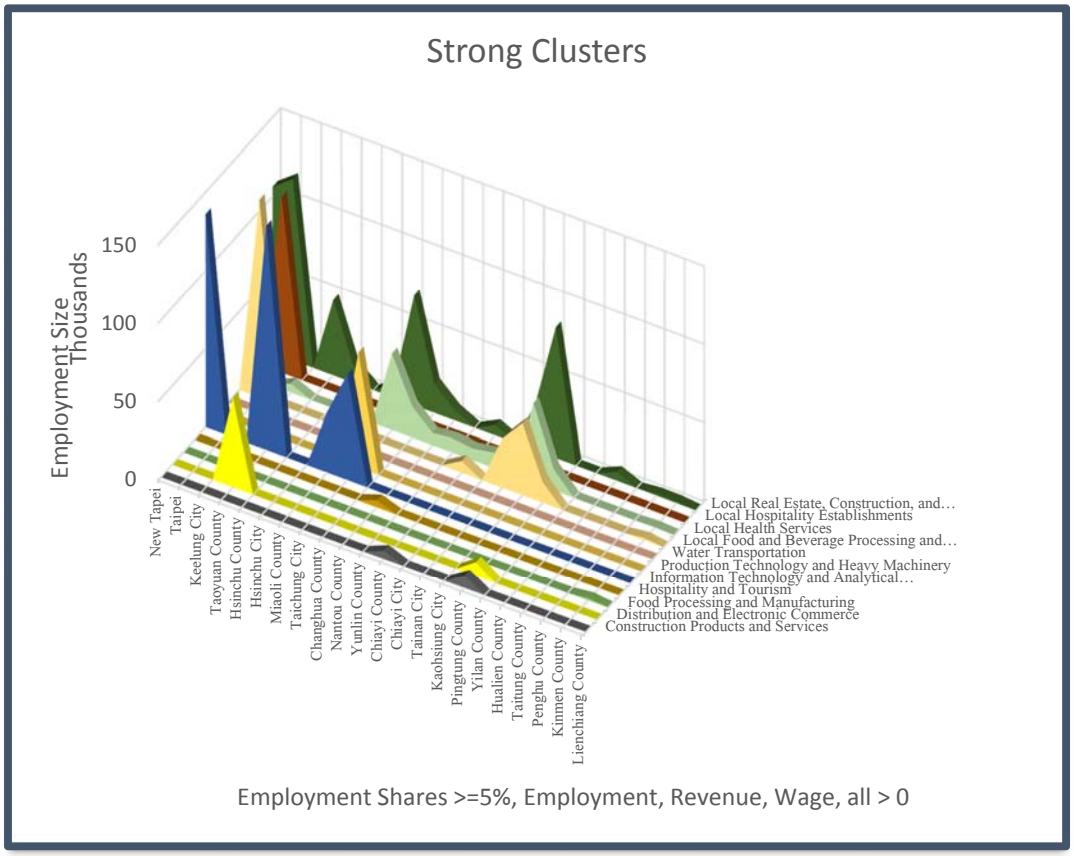
Regions	Traded Dominated Clusters		Local Dominated Clusters
North	New Taipei	IT	Community and Civic Organizations
	Taipei	Business Services Insurance	Food, Hospitality
	Keelung	Business Services	Food, Health Services, Hospitality
Northwest	IT		Food in Miaoli
Middle	Taichung	Production Technology	Health, Community and Civic Organizations
	Changhua	Metalworking Technology, Upstream Metal Manufacturing	Health Services
	Nantou	Hospitality, Construction	Food, Health Services, Hospitality, Community and Civic Organizations
	Yunlin	Textile Manufacturing Construction Products and Services	Food, Health Services, Community and Civic Organizations
	Chiayi County	Food Processing and Manufacturing, Construction Products and Services	Food, Health Services, Community and Civic Organizations
	Chiayi		Health Services, Hospitality, Community and Civic Organizations
	Tainan	Upstream Metal Manufacturing	Food, Health Services,
South	Kaohsiung		Food, Health Services, Community and Civic Organizations

	Pingtung	Construction Products and Services	Food, Health Services, Hospitality, Community and Civic Organizations
East	Yilan	Construction Products and Services	Food, Health Services, Hospitality, Community and Civic Organizations
	Hualien	Business Services Construction Products and Services Hospitality and Tourism	Food, Hospitality, Community and Civic Organizations
	Taitung	Construction Products and Services	Food, Health Services, Hospitality
Outer Islands	Penghu	Business Services Construction Products and Services Hospitality and Tourism	Food, Hospitality, Community and Civic Organizations
	Kinmen	Business Services Construction Products and Services Food Processing and Manufacturing	Food, Health Services, Hospitality, Community and Civic Organizations
	Lienchiang	Hospitality and Tourism Water Transportation	Hospitality

One special note, Nantou is located in the middle of mountain ridge area; although it appears to be in the middle region, but the specialization develops upon its geographical advantage of scenic sites. Its specializations and activities are closer to the Southwest District where the mountain ridge connects the Sun-Moon-Lake in the middle at Nantou and Ali Mountain is at Chiayi County in the south. Often tour buses move from one to the next, and those two sites are rarely missed. Furthermore, Construction Products and

Services are mostly dominated in all regions expect for the middle region and up to the north tip. Below is the map for Taiwan's Strong Clusters.

Figure 12 Taiwan's Strong Clusters.



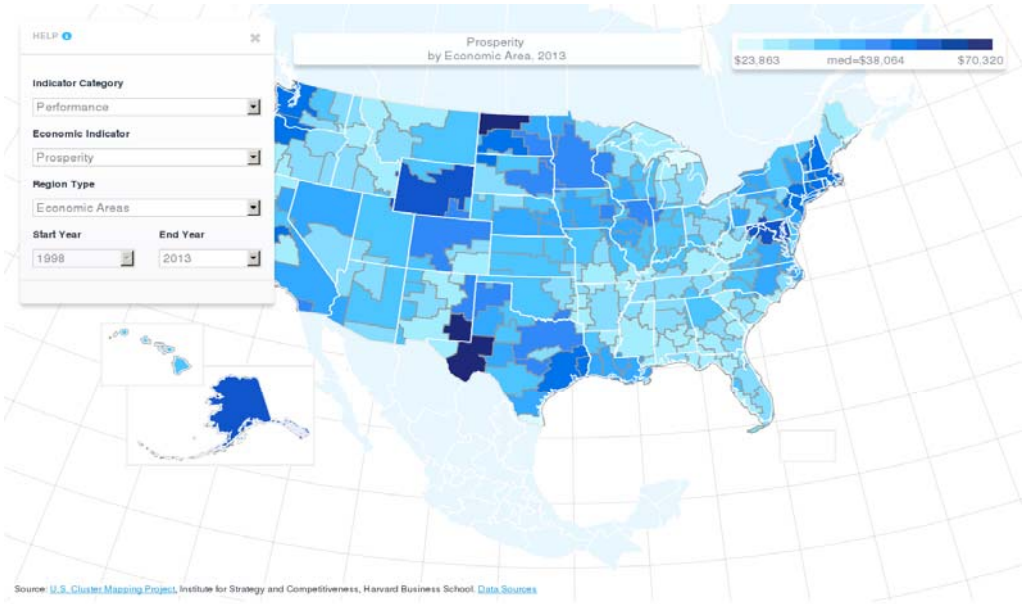
Source: Taiwan National Statistics Bureau

Spillovers can follow the agglomerations on reach a saturation point. Either competition or the labor shortage will trigger the spillovers. The following chapter analyzes some clusters and their spillover potentials.

5.5. Setting up a Web Tool for Users

As an example, the US cluster mapping platform was formally released in September 2014. See below web link:

Figure 13 US Cluster Mapping.



Source: http://www.clustermapping.us/region

This is the US industrial cluster representation based on the latest US cluster definitions. The platform can be dynamically accessed to see economic factors on time, specialty, employment, wages, establishment, location quotient, and patent bases from 1998 to 2013, and the site is updated periodically. The site provides information on Birdseye's view of all states, economies, county areas with rankings in different color shades. This enables everyone's convenience to understand the US economic growths without too much knowledge and learning. It also provides information for people to know where a cluster focused and how active the cluster is. With this, policy makers can gauge the activities and economic growth rates to decide what resources is in demand so that they can give educated calculations on resource allocation such as vocational trainings and grants for cluster initiatives. Thousands of the clusters initiatives have been requested after the launch of the cluster-mapping site, and the government is promoting economic development with updated industry information, thus, brings practitioners and policy

makers closely in collaborations. The newly developed cluster definitions has been worked on since 2000 and has been extended to the latest definition with many years of data collections and evaluations (Delgado, Bryden, et al., 2015, p. 1). The theoretical model has been released by Porter's research group (Delgado et al., 2014; Delgado, Porter, et al., 2015; Porter, 2003). Another example, in 2003, Cluster Mapping was brought to Europe by Örjan Sölvell, Christian Ketels, and Göran Lindqvist in Stockholm by working with Porter and later established the EU Cluster Observatory (Observatory, 2009). Annual The Cluster Initiative Green Book is released to promote initiatives (Orjan, Goran, & Christian, 2003; Solvell & Lindqvist, 2015). Many members from Europe and America jointed Porter's institute to further refine the Cluster research.

Currently, the US Cluster Mapping and the European Cluster Observatory are sharing the same cluster definitions and evaluation structure which can set the framework model for comparative cluster studies for Asia, as well. Data are retrieved from various databanks include census data, labor statistics, tax data, wage data, trade data, establishment data, employment data, business revenue data, expenditure data, and US patents data for cluster analyses, and most importantly, the data are conformed to one normalized method that they can be used to compare with consistency.

5.6. Taiwan's Cluster Definitions

This research defines Taiwan's cluster definitions. The definitions are adapting to the US standard for several reasons. First, top researchers have validated the framework for almost two decades. Second, the framework has been internationally normalized for comparative research. The US has been Taiwan's long-term trading partner, and both share the similar trading behavior and model. Third, the big data movement lead by the US is making the world data open and accessible, and Taiwan usually follows the US standards. Fourth, the US market is the largest and most stables and growing market to be referenced. The market is large enough, and it contains all the cluster's big data with a complete trade flow for many consecutive years. Last but not the least, the whole world has become a mega-economy (Dong, 2009, p. 55), no one can be spared when external shocks hit. A better connection and international networks is a must. The US market is the most active market for Taiwan since the 1970s. Taiwan's economic specialties were

primarily developed along with US technological development such as semiconductor and electronic components industries. Two sets of clusters are divided from the overall clusters, and they are Traded and Local clusters' definitions.

By Porter's definition: Traded industries are industries that are concentrated in a subset of geographic areas and sell to other regions and nations. Local industries are industries present in most (if not all) geographic areas, and primarily sell locally.[17]

Taiwan's local cluster data does not include the education sector that may cause some minor discrepancies, but it will not cause a dramatic shift in the ratio.[18]

In the US clusters' definitions, two groups of clusters were defined. Industries are first classified as Traded or Local. Traded industries are industries that are concentrated in a subset of geographic areas and trade to other regions and nations. Local industries are industries present in most (if not all) geographic areas, and primarily service locally. Within the two large groups, sets of trading industries are then organized into Traded clusters based on an overall measure of relatedness between individual industries across a range of linkages, including input-output measures, use of labor occupations, and co-location patterns of employment and establishments. Local industries are grouped primarily based on similarities in activities reflected in aggregated U.S. industry categories.[19] The Traded Cluster was derived from Porter's research to measure the economic performance, the composition of the cluster, and the role of cluster in the US economy from 1990 to 2000 (Porter, 2003). Porter states "The performance of regional economies is strongly influenced by the strength of traded clusters and the vitality and plurality of innovation."

6. Policy Decision Models – Taiwan, Europe, US

In order to evaluate the cause of the gap between policy makers and practitioners, Taiwan's policy decision model is being compared to other models. The political social interaction is very different from culture to culture. East Asian, despite of political

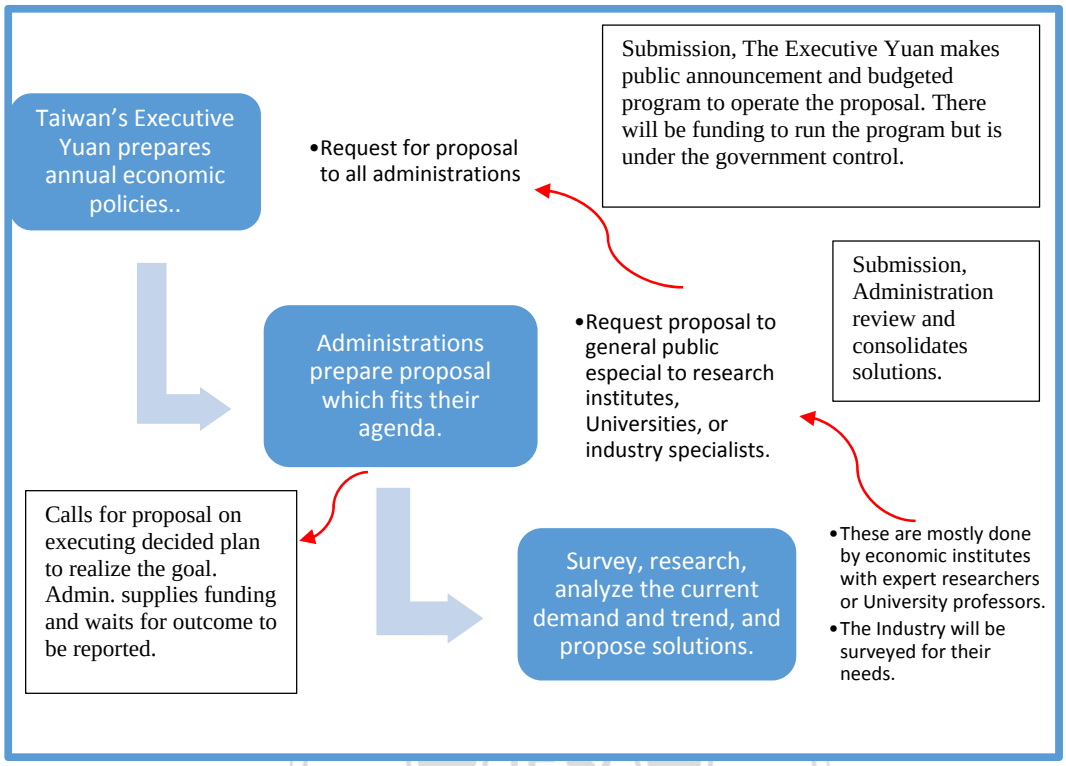
[17] http://clustermapping.us/content/cluster-mapping-methodology
[18] The Local Education cluster is presented at 0 from both 2006 and 2011 Census data.
[19] http://clustermapping.us/content/cluster-mapping-methodology

system, follows the authoritarian decision flows. Given that East Asian has only three democratic and fully free countries, Japan, Korea, and Taiwan. The policy decision models of these countries remain to be top-down model regardless the officials are being voted in the office. Europe being the democracy inception continent, exercise the bottom-up model, and the US have an interactive model. A comparison of the three models is presented below, Taiwan vs US v.s. European Cluster Models – Policy Driven Top-down Model versus Policy Driven Interactive Model versus Vision Driven Bottom-up Model.

"Cluster initiatives are organized efforts to increase the growth and competitiveness of clusters within a region, involving cluster firms, government and/or the research community." (Solvell & Lindqvist, 2015)

Two types of macroeconomics models: top-down and bottom-up, have been distinguished (Grauwe, 2010). Both models have their limitations. Policies made with top-down model may be unrealistic and out of touch for an open market, and the bottom-up model is more ad-hoc without covering the full scope. Information is important for making the "right kind" of decisions for businesses and their sustainability. Criticism for the bottom-up model is that lack of information for the full picture to make decisions that is not complete and not competitive. No one can predict external shocks despite many economists have tried to make the prediction. If it is predictable, it is not called "shocks". Most if not all Asian countries make their policies a top-down model with their economic planning despite of their democratic political systems. Taiwan has had state-planned economic development plan ever since the return from Japan. Back then, the economic planning in the 1970s was focused on technology development and expansions and ultimately made Taiwan a high-tech OEM island. Government continues to plan policies in the same format. Below is a simple flow chart of how Taiwan's policy makers decide on their economic plans.

Figure 14 Taiwan's Policy-driven Top-down Cluster Decision Model.

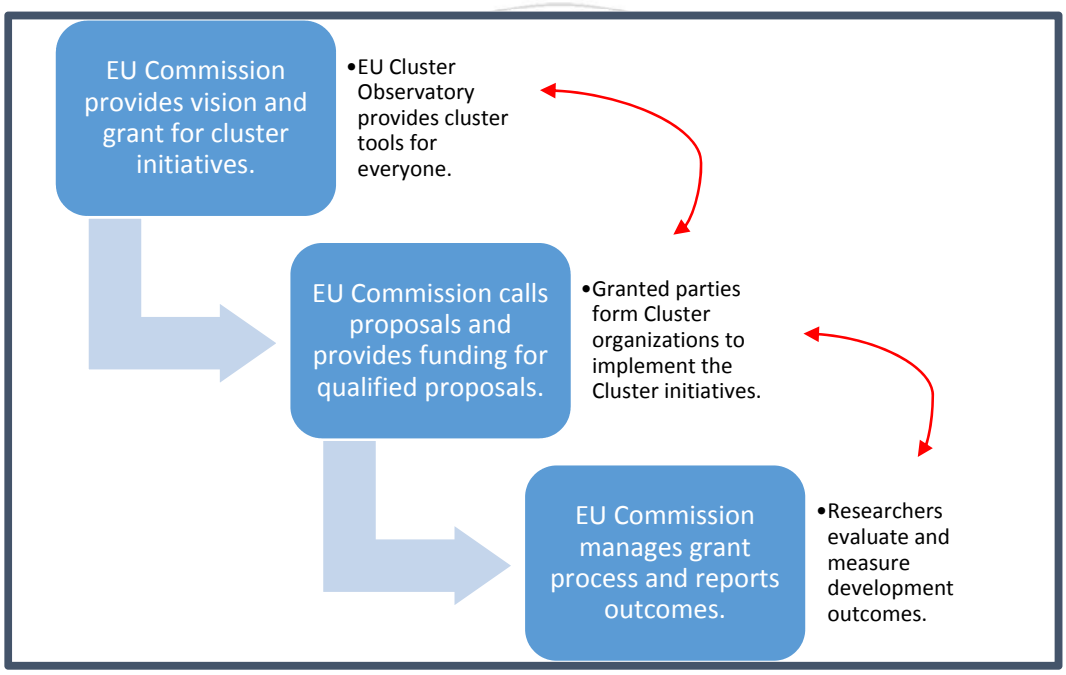


It is a top-down decision model in which the government researchers collect information and propose to the reviewers based on the information collected from various resources, scholars, practitioners, and field researchers, to make the most fitted policies. The plans are reviewed by the government agencies with recommended experts (Yu et al., 2011). Once the policy is made with appropriated funding, the policy will be promoted by the responsible agencies such as Administrations of government divisions. The administration taken over the policy project finds outside institutes or association to implement the plan, and later measure with expected outcome. So the outcome is tailored to the goal of the policy. This top-down policy model used to work well while information access is limited in the earlier eras; people depends on governments to supply outside information while the access to the world information was not easy. Nowadays, information has been opened and with timely reports, making top-down policies appears to be moving too slow, and out of touch. People have the first information faster than the government. Practitioners know their own businesses better

then policy makers, who know the best channels to acquire the most updated information. Many governments are facing the similar issue – too slow to respond, and information are too old (Yu et al., 2011).

Time is changed that technology has provided everyone with ease of access to all information worldwide. Anyone can find almost anything over the web now. Information access has become an advantage to whom has the fastest access and meaningful ways for regular people to understand. Advanced countries, such as Sweden, Germany, have been building expert system online, such as Cluster EU Observatory, so cluster initiatives can be used by everyone. See a simplified process flow of the European model.

Figure 15 European Initiative Driven Bottom-up Cluster Decision Model.



"The European Cluster Observatory has now been in existence for more than five years. Policymakers, practitioners, and researchers use it widely. By 2012 over 2,000 maps were produced every month and over 1,500 document downloaded every month from the Cluster Library. The Observatory is widely quoted in media, in policy papers and in scholarly work." - (Ketels, Lindqvist, & Sölvell, 2012, p. iii) The European model is a

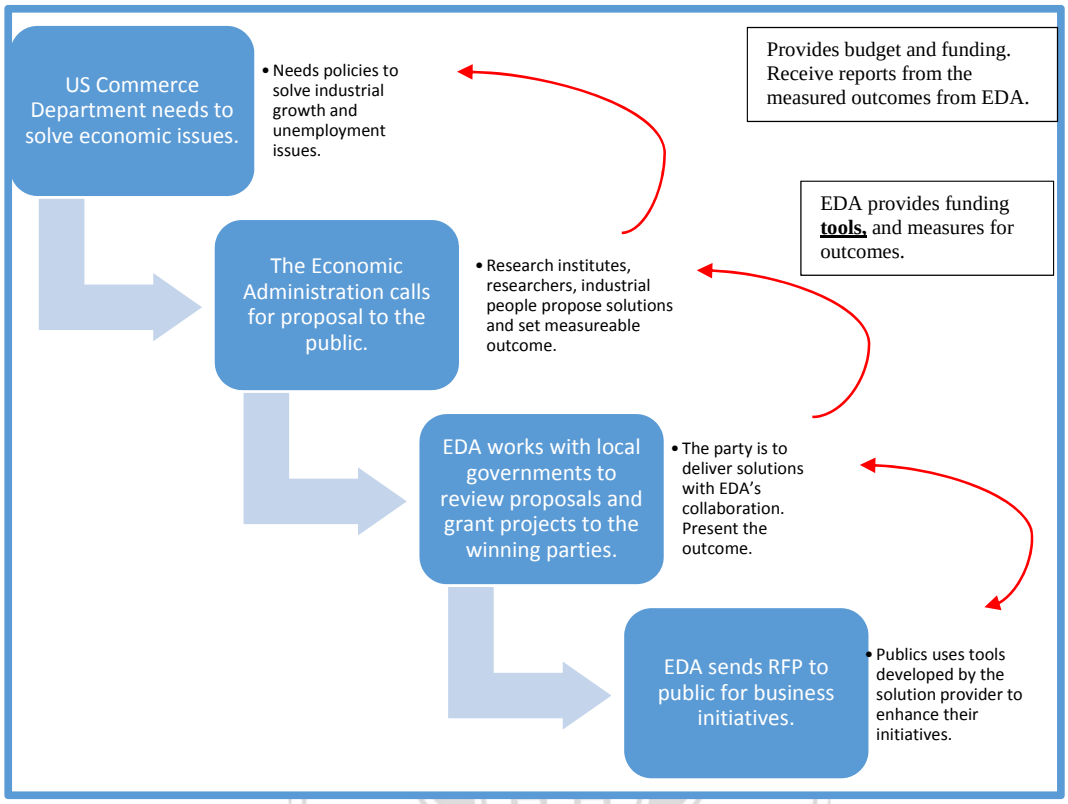
pure bottom-up model that by people's request, policy makers respond to the initiative proposal.

After the 2008 financial crisis, the US, facing the big employment challenges found that their policies are out of place and not able to react to the external shocks or quickly recovery from a shock. The Brooking's policy research team recommended for the US to initiate policies on strengthening the regional competitiveness throughout the US by working directly with the publics to provide in time information assessment tools for everyone's use. (Mills, Reynolds, & Reamer, 2008) The goal was to make policy makers to work with practitioners to be productive and competitive, and to create jobs.

> …the federal government should establish an **industry clusters program** that stimulates the collaborative interactions of firms and supporting organizations in regional economies to produce more commercial innovation and higher wage employment.
>
> - (Mills et al., 2008).

Government sets policies on a periodical basis to review people's needs. Technology upgrades has been pushing information updates faster than big organizations can react, especially the large body of bureaucrats. One simple decision may take layers of reviews and meetings to make. By the time policy is made, the issue has evolved to the next level. On the other hand, the bottom-up, trail-and-error model, is often being criticized as to being too ad-hoc and without a supporting structure and validation. A mixed model may compensate for both disadvantages. The US has changed its new flow to cluster initiatives for policy makers to provide the updated information tools for businesses and organizations use and to initiate local prosperity projects, and in the meantime the local governments proactively interact with citizens to request for proposals. The flow is as follows.

Figure 16 US Cluster Initiative Cluster Initiative Decision Flow.



As a result, the US Cluster Mapping is designed by policy makers for people to quickly assess industrial information, understand their business environment, and make their initiatives realistically in time, so that they can create jobs and prosperity. The first and immediate updated information helps businesses to be competitive. This is a top-down policy initiative to make the bottom-up cluster initiatives more competitive globally. This policy provides a free flow of information and created a channel for an interactive communication by utilizing the latest technology. So, I name it the interactive-decision-model. When information was not readily available, the best policy maker can do is to depend on experts in the field to study what is the best to offer and allocate resources and setup programs for people to follow. Now with the interactive expert system, people rely on the latest information update to make the most measurable decisions. The benefit of an interactive expert system is for people to make decisions and take calculated risks with the best educated estimations, so that they can be better control the risks. Having sufficient information to compete is the strategy.

To summarize, cluster initiatives are created to promote economic prosperity, and different governments implement their cluster initiatives differently. Taiwan has a top-down model, European has a bottom-up model. The US has an interactive-model. To compare the three models, below chart explains the differences.

Figure 17 Comparison on Taiwan-EU-US cluster initiative decision models.

	Model	Tools	Policy Makers	Practitioners and researchers
Taiwan	Policy Driven Top-Down Cluster Model	Experts research data; government disseminates information on web	Set goals, design and promote cluster initiatives	Through programs and competitions to receive grants and assistance from the central government or its appointments
EU	Goal Driven Bottom-up Cluster Model	EU Cluster Observatory provides Cluster Mapping web data portal	EU sets visions, promotes the vision, and calls for initiatives; EU officers interacts directly with Cluster Organizations	Submit Cluster Initiatives for grants from EU or local governments, and set Cluster organizations to manage the interaction among stakeholders within the organizations
US	Policy Driven Bottom-up Cluster Model	Experts research data; government provides US Cluster Mapping tool on web and promotes cluster initiatives	Set goals and interact with local governments to call for initiatives, local governments interact directly with the publics	Submit Cluster initiatives to receive grants and assistance from local governments; final outcomes are reported back to the funding agencies

In Taiwan's top-down level, the government has the least interaction directly with the publics; the demand and feedback are often not heard by the policy makers in time, and Technology innovation is one of the major goals. The outcome is not measured by job creation, but by how many companies going public and are engaged in mergers, market trading returns, which was documented in the White Paper (Industrial Development Bureau, 2015, pp. 191, 258-267) as measurement for the success.

The European model is set with a clear vision, and all initiatives are granted based on the submission proposals that matches the vision closely. The non-profit EU Cluster

Observatory designs and provides as much as information conveniently for open assess, so that everyone can use the information to design their own initiatives to reach the big vision. Job creation is the ultimate outcome measurement.

The US policy driven interactive model provides interaction governments and publics. The national government is providing the guidelines and needed assistance. Job creation is one of the measured guideline by the funding agencies. The outcomes are measured against the goal, and job creation is the major goal. This is an interactive government-public model.

7. Taiwan's Economic Landscape

7.1. About Taiwan

The following describes Taiwan in general and followed by the regional analyses. In the case of a small economy, Taiwan with limited or lack of endowment and natural resources can face extreme harsh conditions while facing a global economic crisis. When the 2008 subprime financial crisis started in the United States creating a domino effect to all economies globally, the impact was detrimental. Some economies survived, and some crashed. Most economies include Taiwan cannot be sheltered from the crisis except to find the best way to survive and reshape simply because most economies are not prepared for external shocks of this magnitude. Some economies rebounded faster, and some economies are completely destroyed[20].

Taiwan's prosperity took a dive in 2009, and the industries reacted to the shock trying to recover the damage. Taiwan being bit fortunately that the better-equipped industry clusters rebounded from the shake such as semiconductor OEM businesses, and some industries have lost their momentum such as Downstream Metal Products. Communities across the board have voiced the needs to analyze Taiwan's economic conditions and their related industrial clusters to analyze the damages done by the crisis and solutions to for a post crisis recovery. Consequently, this research correlates the growth rates to

[20] Taiwan rebounded within a year, and EU went through some massive economic aftershocks.

determine the dynamism of cluster in regions with cluster weaknesses and strengths after the external shock.

One of the industries, Downstream Metal Products were severely impacted with an around 20% annual down rates. A research was done to look into the cluster's issue, and the report aimed to give recommendation to stakeholders and can be a draft for a cluster initiative (Tan et al., 2015). Overall, Taiwan's downstream products did not sustain, but the upstream production survived the shake. On one hand, when an external shock encounters, there are opportunities for those well-prepared industries to upgrade, but it also depends on how strong the industrial infrastructure is. Government can utilize public policy for economic stimulation, but that is only short-term to recover from the shock. It is important to prepare ahead so that when shock struck, clusters have ways to avoid damages.

On the other hand, future shocks can be opportunities for well-prepared businesses to take the advantages for expansion. This can create a breathing window for the economic gaps not to enlarge as an internal economic imbalance which can cause the economic disparity or social unrest. In other words, crisis can be beneficial if financial policies are set in accordance to a country's social progress and industrial demands. Regardless, industry practitioner and policy makers need to work collaboratively to plan for the unexpected. During the crisis, Taiwan has taken the initiative to give cash to all citizens to encourage economic stimulation. Each person was granted NT$3,600 coupon toward any purchase to stimulate consumer spending (Dong, 2009, p. 8). The domestic spending could not help industries for the long term recoveries as it was a way for a short-term stabilization.

Those who are well prepared took the opportunity and reacted to crisis and advanced their economies because they are ready. One good example is Singapore. Its "Next Lap" plan worked during the 2008 crisis. "External events can shake us, as they have in the past, nothing is certain." Singapore policy makers took external shocks seriously and initiated research and policies to prepare for the worst, and designed a track for the future prosperity. Earlier, Porter's team member, Christian Ketels in 2006, was invited to work with their researchers and policy makers on cluster initiatives and released Remaking

Singapore (Porter, Neo, & Ketels, 2010). The collaboration work through the initiatives was an important preparation foundation to deal with the external shocks. Singapore past the test of 2008 global crisis.

Singapore's GDP per capita had a sharp rise after the 2008 financial crisis from US$33,578 in 2006 to US$52,870 in 2011[21] with a Compounded Annual Growth Rate (CAGR) of 9.5%, and there may be a small dip in the 2009 but bounced back in 2011 with a fast rise. It is very unusual for a developed country to reach a two-digits economic growth rate, especially after a global crisis. Why is Singapore able to do that? The shift is an evidence that Singapore was fast to response to the external shock. Some foreign banks had to laid off people and move back to their own countries, but Singapore's economy overall stayed on a focused and healthy track. Consider the Gross World Product (GWP), Growth Rate is averaged 5% with 2008s in 3.1% and 2009 a zero percent, Singapore is doing extremely well. Singapore has ended its status as a developing economy and has officially become an advanced economy.

Figure 18 Gross World Product Growth Rate by Region[22].

Gross world product growth rate by region (%)											
Region	**2006**	**2007**	**2008**	**2009**	**2010**	**2011**	**2012**	**2013**	**2014**	**2015**	**2016 (est.)**
World average	5.5	5.7	3.1	0	5.4	4.2	3.4	3.4	3.4	3.5	3.8
Advanced economies	3.1	2.8	0.2	-3.4	3.1	1.7	1.2	1.4	1.8	2.4	2.4
Eurozone	3.2	3	0.5	-4.5	2	1.6	-0.8	-0.5	0.9	1.5	1.7
Developing countries	8.2	8.7	5.8	3.1	7.4	6.2	5.2	5	4.6	4.3	4.7

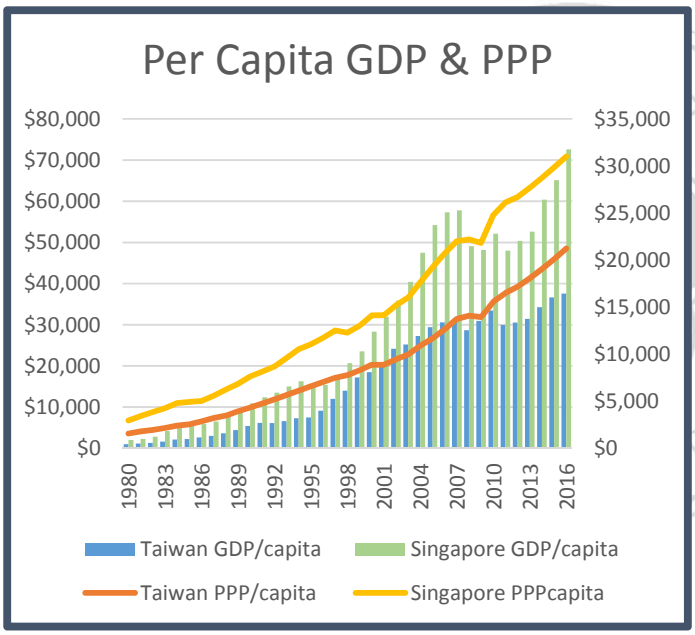
Source: IMF

[21] Source: The World Bank

[22] according to the International Monetary Fund (IMF)'s World Economic Outlook database. Data is given in terms of constant year-on-year prices. "Report for selected country groups and subjects". *World Economic Outlook*. International Monetary Fund. 2015. Retrieved 20 October 2015.

Evidently, in 2009, Prime Minister Lee Hsien Long formed an Economic Strategy Committee (ESC) chaired by the Minister of Finance and comprised of 25 members drawn from government, unions, and companies. The aim was to provide recommendations on how to support sustainable future growth. The realization was clear; an initiative can only be successful with all stakeholders involved. The initiative captured the essence of the structural analysis and made it useful. Singapore's GDP per capita compared to Taiwan is growing faster. During 2008, both Singapore and Taiwan were hard hit by the global financial crisis, and both recovered after 2010., but Singapore moves on a faster growing pace than Taiwan.

Figure 19 GDP/capita and PPP/capita for Taiwan and Singapore.



Singapore's GDP dropped sharply after 2008, bounced back in 2009, but dropped again in 2010 before rising again. Singapore's GDP has jumped significantly.

Similarly, Taiwan's GDP took a dive after 2007 but slowly ramping up after 2009 with an extra fluctuation in 2010 before ramping up slowly again. PPP remains appears to rise more than the GDP which is worth to compare the currency rate difference. Taiwan's GDP remains slow growth after the recession.

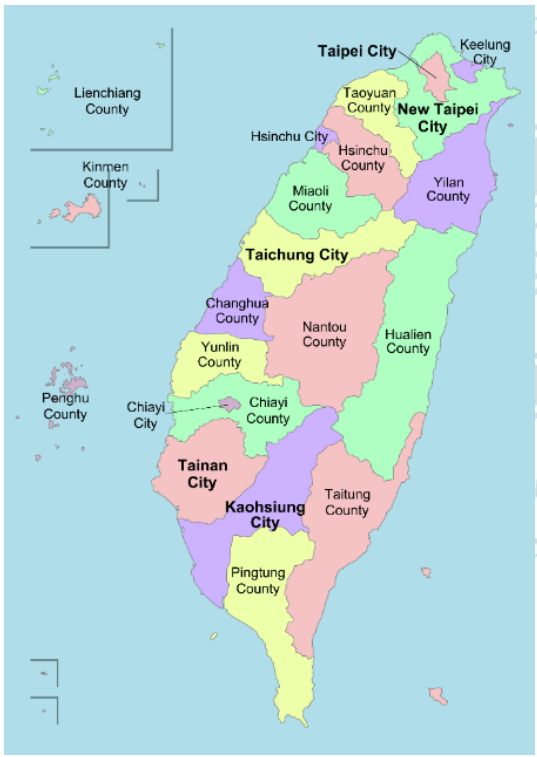
Source: World Economic Outlook, IMF

The macroeconomic calculation of GDP even PPP is limited to identifying a true picture of regional economy and people's wellbeing. Policies makers can only rank national comparisons on competition results, but they are not able to identify where the problems are and to allocate resources to the critical aides. This is not an easy problem. It is comprehensive and structural, and a simple economic modeling and ranking is not enough to make precise conclusions and draw recommendations to businesses owners

and policy makers to make effective plans. The economic system of a nation needs a comprehensive health checkup tool, and economists in the world are working hard on contributing to create diagnostic tools for the checkup. As an old saying, finding the problems is half of the answer. This research defines a set of analytical tool which is data-driven and evaluates dynamics of industrial clusters to identify challenges and opportunities in relating to location specialties and productivity.

7.1.1. Taiwan's Demographics

Figure 20 Map of Taiwan.



Taiwan is geopolitically important for the East Asia. Its close neighbors are China, Japan and the Philippines. Economically, it has made some remarkable progress.

Source: http://www.balticasia.lt/wp-content/uploads/2015/11/taiwan.png

Figure 21 Taiwan in East Asia.

Taiwan is centrally located in the middle of East Asia positioned at the maritime gateway between the Northeast and Southeast Asia.

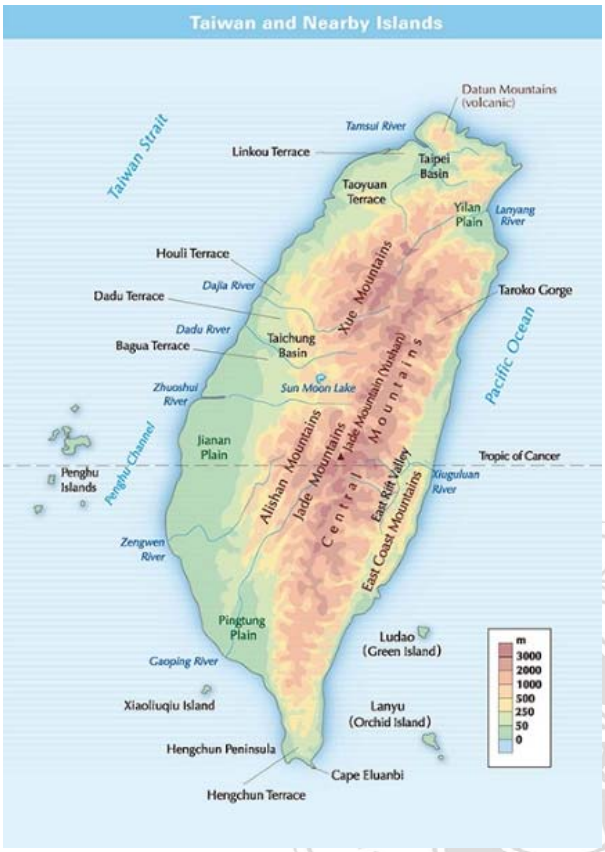
Source:
https://upload.wikimedia.org/wikipedia/commons/thumb/e/e7/Taiwan_ROC_political_divisions_labeled.svg/2000px-Taiwan_ROC_political_divisions_labeled.svg.png

Taiwan has the second highest population density in the world behind only Bangladesh. The highest city population density is Taipei City with 9,950 per km², and the highest county population is Changhua 1,200 per km² with a Taiwan average density of 650 per km². The density is rising but per house headcounts are decreasing[23].

7.1.2. Taiwan's Geography

[23] Taiwan Statistics Bureau

Figure 22 Taiwan's Geography.



Taiwan has a dramatic mountainous central terrain with the highest point close to 4,000 meters in elevation. Most flat and livable areas are concentrated in the west side of Taiwan.

North is where central government and financial institutes head quartered. Most agriculture activities are in the south. Manufacturing are clustered in the middle region. The east side has light industries and agricultural activities. High-tech and semiconductor clustered in the Northwest area.

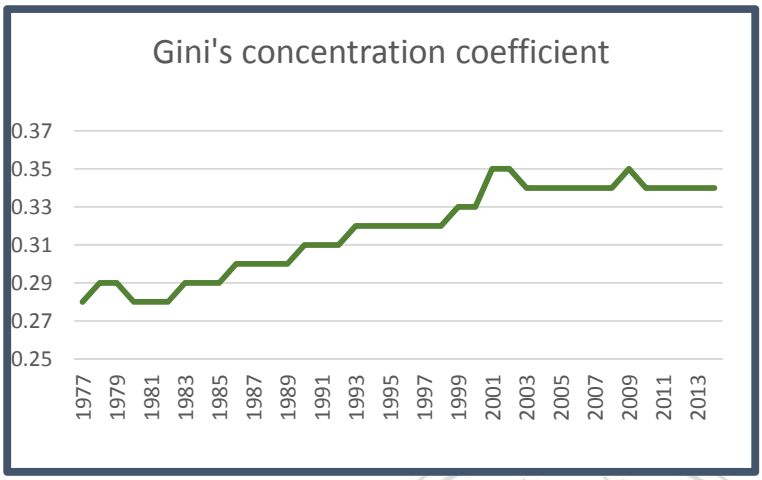
Taiwan has 3 important ports, Keelung, Taoyuan, and Kaohsiung. The international airport for passengers and goods is at Taoyuan City, Taichung, and Kaohsiung, and Taoyuan being the major airport.

Source: http://www.taiwan.gov.tw/ct.asp?xItem=126579&CtNode=3761&mp=1

National Chengchi University

7.1.3. Taiwan' Economics

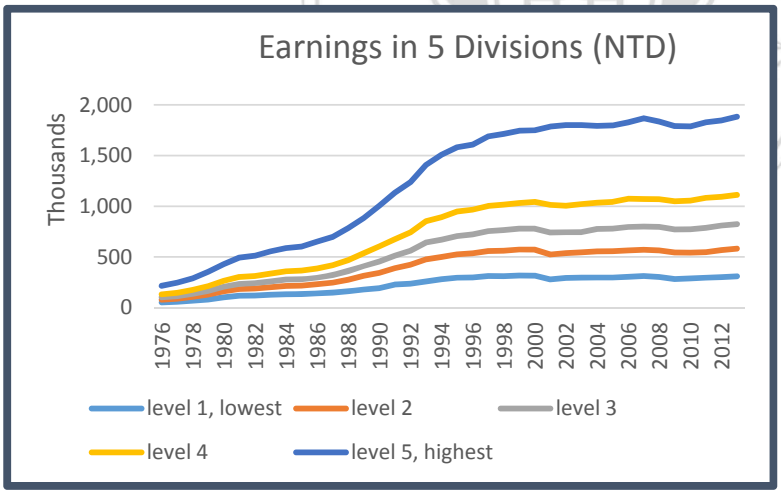
Figure 23 GINI's Concentration Coefficient.



With a GINI of 0.342, a top 21 of the world but rising.

Source: Taiwan National Statistics Bureau, US CIA

Figure 24 Taiwan's Income gaps.

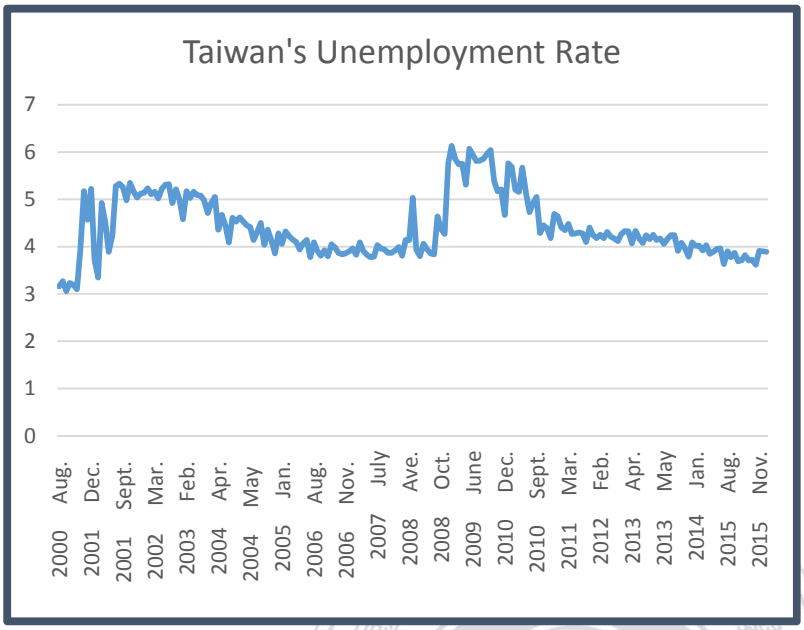


Taiwan's pay inequality is the highest in the top pay level.

The income gap widens in a faster pace after the 1980s. The 1990s marks the fastest widening period and leveled after 2000.

Source: Taiwan National Statistics Bureau

Figure 25 Taiwan's Unemployment Rate.



Taiwan's Unemployment Rate peaks at the year of 2009 right after the global sub-prime financial crisis. It starts to recover after some small fluctuations, and the largest unemployment rate is the age group between 19-29.

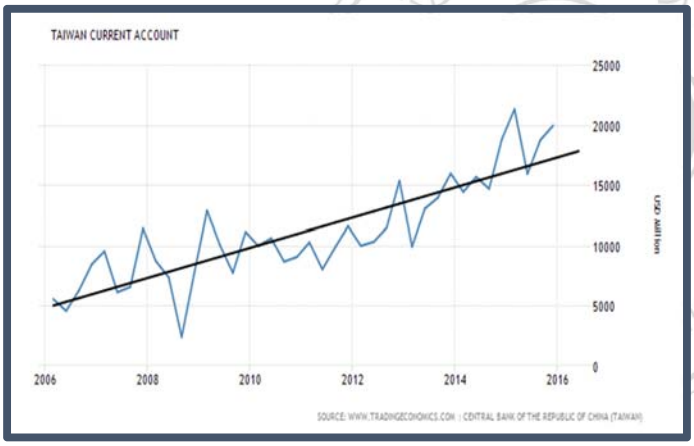
Source: Taiwan National Statistics Bureau [24]

Taiwan in the 1990s had a fast economic rise. Wage gaps widened in a faster pace on the top 20% earning group (Figure 24). The1980s and 1990s are Taiwan's memorable decades. There were a few events forced Taiwan to change. One biggest event was that Taiwan became democratic in 1985. Taiwan made the top of the "Four Little Dragon" Asian economies listed ahead of Korea, Singapore, and Hong Kong. "Made in Taiwan" was displayed on American movies in the 1980s. Taiwan went prosperous in two ways. Taiwan became an international trading nation, and Taiwan is close part of the production networks with Silicon Valley. Taiwan had brain drain from the 1970s to brain circulation in the 1990s (Saxenian, 2002, 2005). Taiwan became a computer kingdom in the 1990s. This is when Taiwan's earning gaps widened the most.

[24] http://eng.stat.gov.tw/ct.asp?xItem=15761&ctNode=1609&mp=5 , selection on Major Indicators, retrieved on 3/13/2016

Taiwan's Gross Domestic Product (GDP) per capita went from US$1 in 1936 (Gold, 1986) to US$23,456 in 2015 with a Purchase Power Parity (PPP) of US$45,854. It means that Taiwan's inflation is well controlled, and currency is maintained for the country trading advantage that Taiwan has a balance of trade NTD138 Trillion (US$4.5 Trillion)[25] at the end of 2015. Taiwan ranks 6th among the world trade surplus[26] nations with US$64 Trillion current surplus in 2015, just behind the Netherlands.[27] Taiwan's current account is growing but the ranking is declining in surpluses. The decline is the first sign of warning.

Figure 26 Taiwan's Current Account.



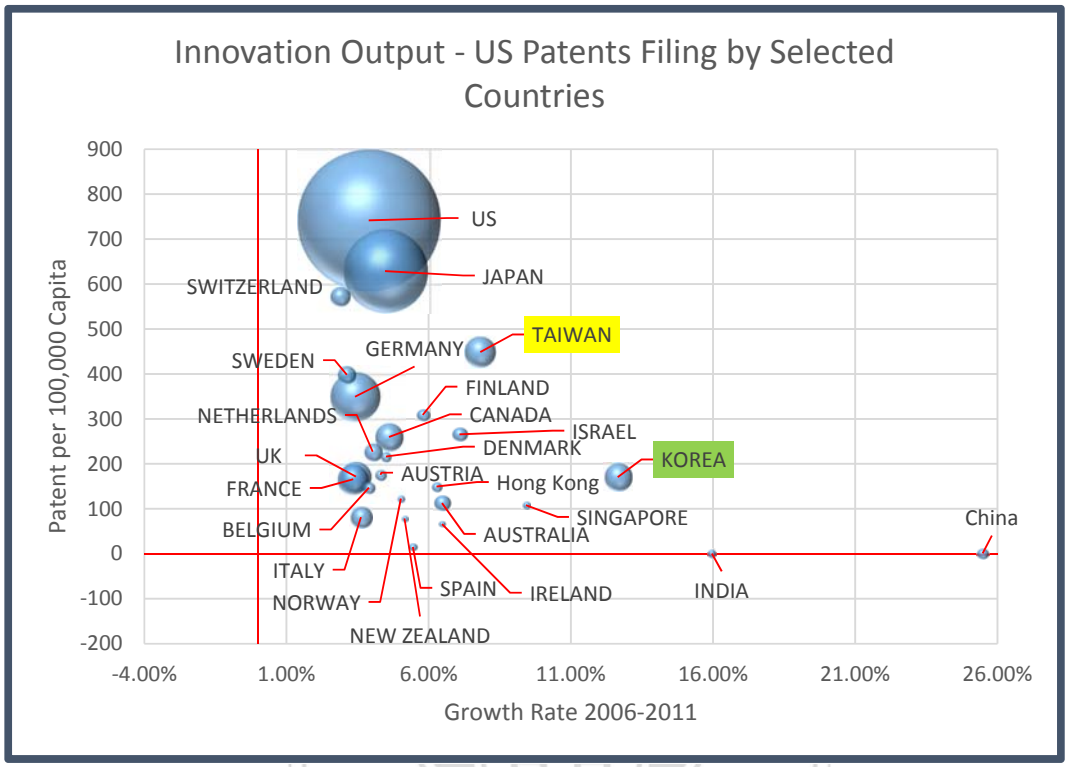
Taiwan's Current Account Indicators shows that Taiwan is doing rather well especially after the 2008 financial crisis. Economic data shows a deep dip in the 2009 but rebounded after 2010, but overall, it is on the rise.

Source: Trading Economics[28]

Taiwan's innovation output ranks 4th highest behind US, Japan, and Germany, and has potentials to expand. Korea is a close economic competitor of Taiwan, and its growth is faster than Taiwan despite the per capita innovation is smaller. See below Figure 27 for Innovation Output.

[25] http://www.tradingeconomics.com/taiwan/balance-of-trade
[26] https://www.cia.gov/library/publications/the-world-factbook/rankorder/2187rank.html
[27] Taiwan's Economic Decline_ Market Solutions Key to U.S (paper in literature directory); http://www.forbes.com/places/taiwan/ , what Forbes says about Taiwan.
[28] http://www.tradingeconomics.com/taiwan/current-account, retrieved 3/14/2016

Figure 27 US Patents by Selected Countries.



Source: US Patent Office

During the financial crisis, TSMC had to lay-off some workers in early 2009, but rehired them back after one year and paid them pack all their loss wages.[29] The two famous Taiwanese companies in the electronics industry are TSMC and Foxconn. One makes specialized semiconductor wafers, and another produces electronic products. They are both agglomerated from a small business startup in 1974 for Foxconn and 1987 for TSMC. The island economy has become an electronics production hub for the US and other parts of the world. Taiwan's employment is closely tied to the landscape of Taiwan's industrial clusters. Electronics being a major part of the national income. These two companies are doing very well after the recession is over. Both companies rank very high on innovations and compete severely with Korean competitors. How about the rest of the clusters? How are they doing? Who are the winners and who are the losers? In the

[29] http://www.taipeitimes.com/News/biz/archives/2009/05/21/2003444171

later Cluster Analysis (see Taiwan's Economic Analysis), the employment gains and losses will be mapped with other growth rates to answer these questions.

Using the Figure 6 DSE system, the regional (Districts in this case) Cluster Scores are as follow.

Figure 28 Taiwan's Regional Cluster ID Scores.

Cluster ID Scores	All 2LQ-LQ-ES-EG-RG-WG*	Traded Clusters 2LQ-LQ-ES-EG-RG-WG*	Local Clusters 2LQ-LQ-ES-EG-RG-WG*
North	3,019,005,031,043,040	2,013,003,022,033,030	1,006,002,009,010,010
Miao-Chu-Tao Northwest	3,012,003,041,046,020	3,011,002,029,035,020	1,001,012,011,001
Middle	7,023,006,038,048,010	7,018,003,028,036,010	5,003,010,012,000
Southwest	7,029,004,035,043,020	7,020,001,024,032,020	9,003,011,011,006
South	4,022,006,032,043,030	3,012,002,022,031,020	1,010,004,010,012,010
East	10,013,006,033,042,000	7,005,002,023,031,020	3,008,004,010,011,000
Outer Islands	8,013,008,039,035,020	6,003,004,025,026,020	2,010,004,014,009,010
Taiwan total	61,005,000,000,000	46,003,000,000,000	15,002,000,000,000

** for Employment Shares 5% and over.*
(2LQ=location quotient is 2; LQ=location quotient is 1; ES=cluster employment shares; EG=# of clusters with employment growth; RG=# of clusters with revenue growth; WG=# of clusters with wage growth)

To interpret the Cluster ID Score, say for North Region of all clusters, 3,019,005,031,043,040: Overall, Taiwan has 3 major traded clusters (IT, Ecommerce, Business Services), and 2 major Local clusters (Food, Health). The North region has 3 highly specialized clusters; 19 specialized clusters; 5 clusters with over 5% regional employment shares; 31 clusters with employment growths; 43 clusters with revenue growths; 20 clusters with wage growths.

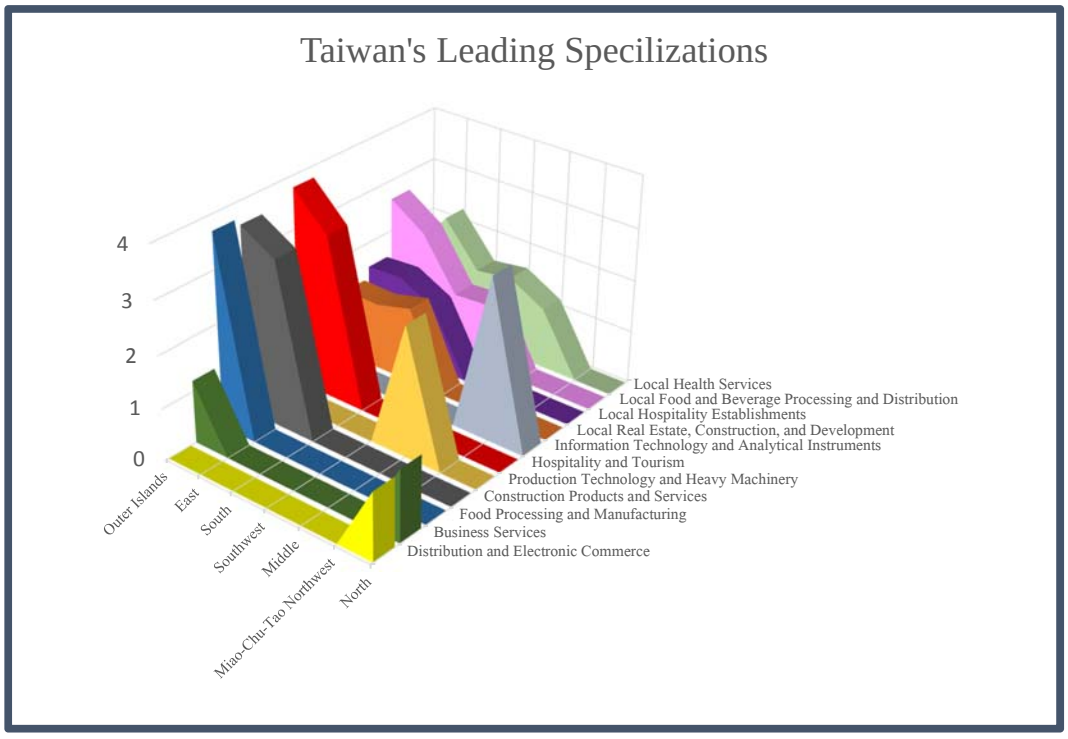
For the Northwest region of Traded Clusters, 3,011,002,029,035,020: From the traded clusters, the Northwest region is highly focused region with 3 highly specialized clusters (IT, Distribution and Ecommerce, Oil and Gas Production and Transportation), 11 specialized clusters, 2 (clusters IT and Distribution and Ecommerce) over 5% shares. 29 clusters are going employment; 35 clusters are going revenue, and 20 clusters wage rise.

The Middle region is more evenly spread out in larger clusters. The Southwest has more varieties of specializations and more spread out in smaller clusters. The East and Outer Islands regions are mostly highly specialized clusters due to isolation and smaller populations.

7.2. Taiwan's Specializations

Below is a Taiwan's leading specialization landscape by the district-region, and the calculation is based on LQ>=1, Employment Shares >=5%

Figure 29 Taiwan Leading Specializations.



Source: LQ map, data from 2006-2011 Taiwan Census, Taiwan National Statistics Bureau

From the map, the 3 major Traded Clusters are concentrating in the northern regions, and Production Technology is in the middle region, and the rest spread out in the South and Outer Islands. This also tells the story that Taiwan's major economic concentrations are

tilled toward to the north, but the Local clusters are tilled toward the south. Figure 30 provides the precise details in each district.

Figure 30 Taiwan's Leading Specialization in Districts.

Districts	Traded Clusters	Local Clusters
North	Business Services; Distribution and Electronic Commerce	
Northwest	Information Technology and Analytical Instruments	
Middle	Production Technology and Heavy Machinery	Local Health Services
Southwest		Local Food and Beverage Processing and Distribution; Local Health Services
South		Local Food and Beverage Processing and Distribution; Local Health Services; Local Hospitality Establishments; Local Real Estate, Construction, and Development
East	Construction Products and Services; Hospitality and Tourism	Local Food and Beverage Processing and Distribution; Local Health Services; Local Hospitality Establishments; Local Real Estate, Construction, and Development
Outer Islands	Business Services; Construction Products and Services; Food Processing and Manufacturing; Hospitality and Tourism	Local Food and Beverage Processing and Distribution; Local Health Services; Local Hospitality Establishments; Local Real Estate, Construction, and Development

This provides a clear picture how Taiwan is mapped with the specializations. For the Traded clusters, the North region is primarily Business Centered with Services and Ecommerce. The Northwest region is heavily focused on IT. The Middle region is the Production Technology base. There is no primary focus in the South and Southwest regions. The East region is primarily Tourism and Construction Material Businesses. The Outer Islands region is small, isolated and diversified with limited clusters and four highly specialized industries.

For the Local clusters, the further one moves toward south, east, and outward, the more specialized local clusters, they are more diversified. The economic development is imbalance with Traded in north and Local in south. From the observation of IT cluster,

when a specialization agglomerates by employment shares in a populous city, it becomes a leading industry. The wages start to rise with employment growth rate slow down, the spillovers are most likely to the adjacent regions.

7.3. Evaluation Factors on Dynamics

Now we understand Taiwan's specialized landscape. We can move forward toward dissecting the dynamics evaluations and the impacts to each city region. When the data contains a shock period, this gives an interesting perspective to see how Taiwan is surviving and its economic landscape shifts. There are some winners and some losers. Once the data is cleaned and processed, we take the second step to calculate clusters' dynamic and further run Pearson correlation on traded cluster growth rates among employment, revenue, and wages. The result correlates highly on all clusters with the exception of Outer Islands. (See Appendix - Pearson's Correlation on Traded Clusters' Growth Rates) The cluster map will echo the same findings. With the same correlation method, among the local clusters. The wage growths do not correlate with neither the employment nor the revenue growths, but the local employment and revenue growths correlate well. (See Appendix - Pearson's Correlation on Local Clusters' Growth Rates) Furthermore, a cluster map on the specializations and growths were created for each city to see the dynamics of the winning and losing clusters. Below defines the calculation formula of each factor.

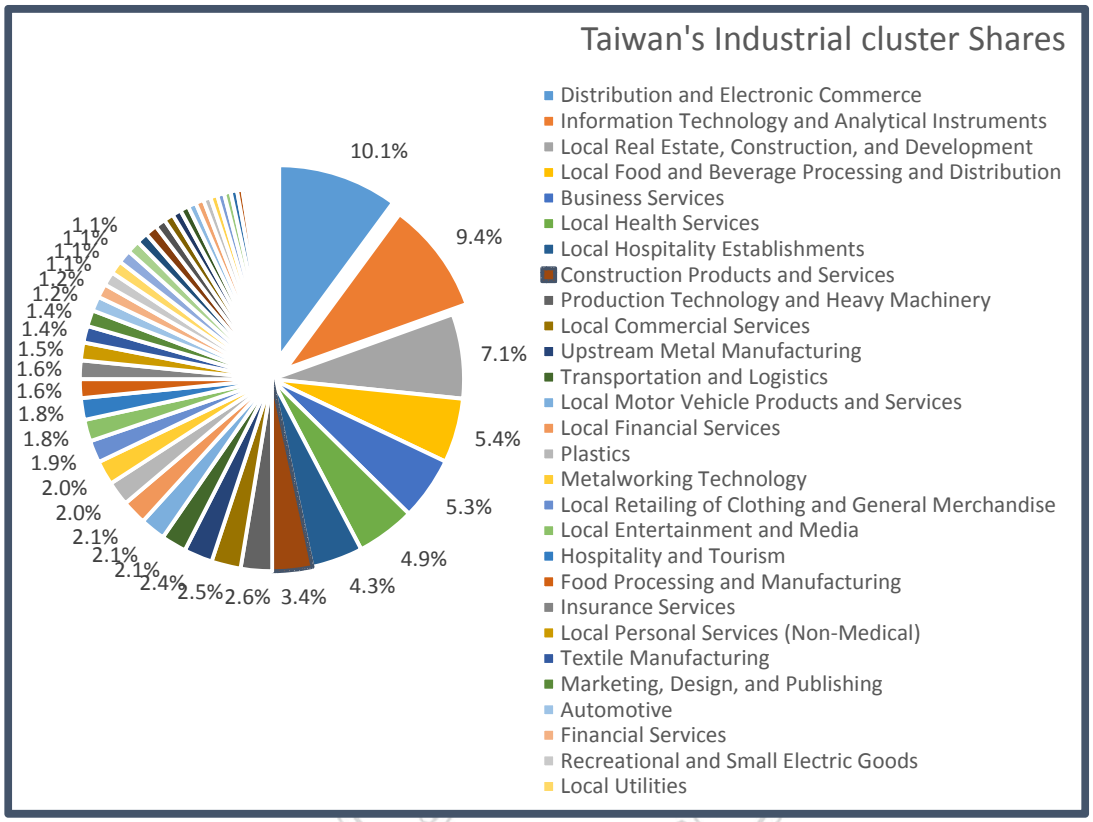
7.3.1. Employment Factor

The first factor is employment. The employment size tells which cluster has more impact in the region and whether the region specializes in some clusters, and if a particular cluster is expanding with the regional workforce. A strong specialized cluster with high regional employment growth means the region is very competitive in that specialty.

The employment share is an indicator to gauge how attractive a cluster is in a region. Calculating the shares can show how productive is the cluster in the region. Below is a pie-chart showing clusters' shares in Taiwan. The top clusters are Distribution and Electronic Commerce, and Information Technology and Analytical Instruments that are

around 10% of the total employments. The third Traded cluster is the Business Services around 5% shares.

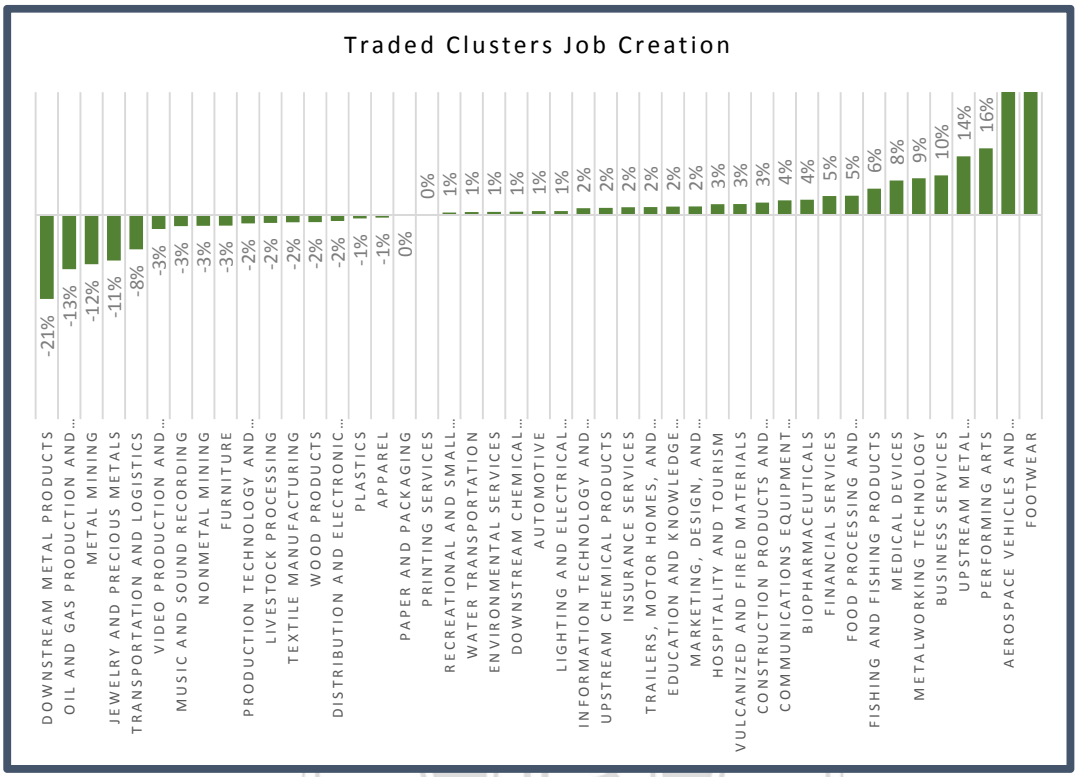
Figure 31 Taiwan's Industrial Cluster Shares.



Source: calculation from *Taiwan National Statistics Bureau* Census Data, 2006-2011

Below is a list of job growth ranking with the calculation from Taiwan's employment growth rate (CAGR) from the year 2006 to 2011, and followed by the shares of clusters.

Figure 32 Traded Clusters' Job Creation.



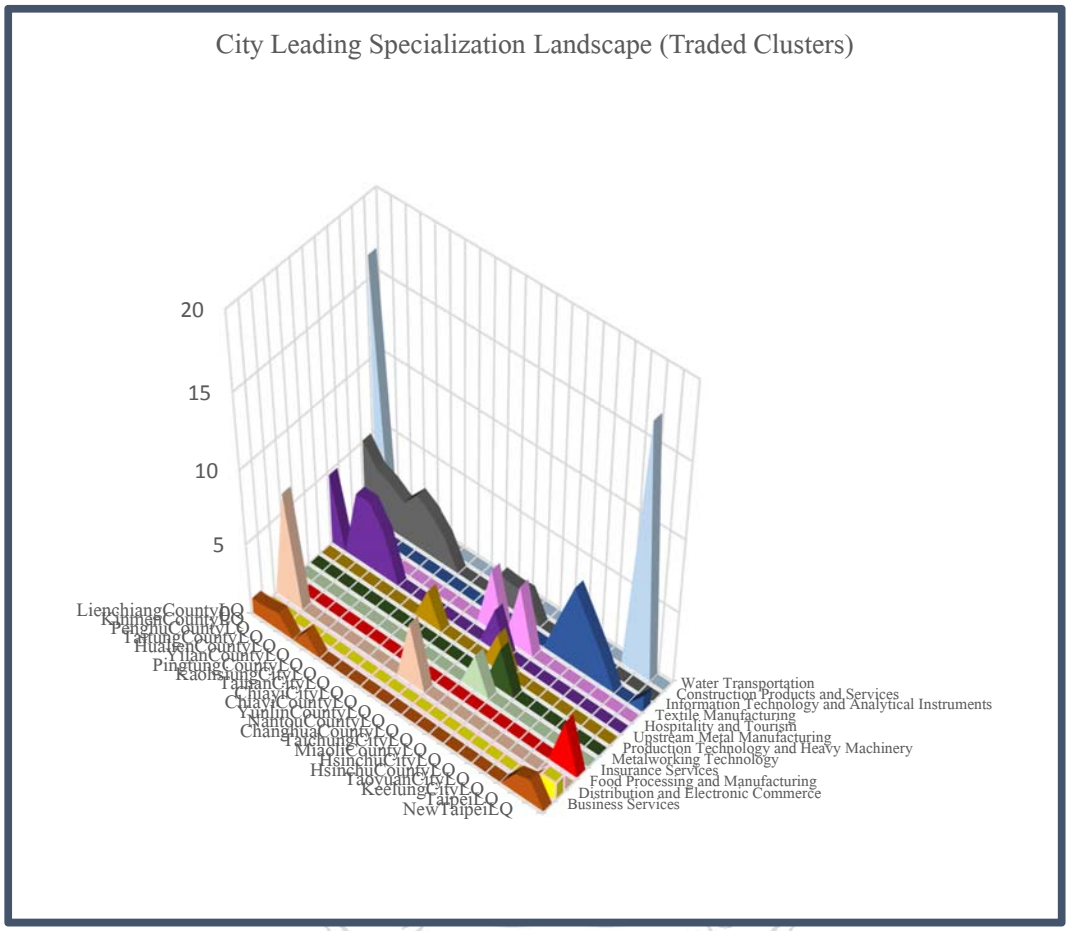
Note: Footwear is regrouped from Leather goods, therefore shows high growth.
Source: *Taiwan National Statistics Bureau*,

Five top declining traded clusters are Downstream Metal (-21%), Oil and Gas Production & Transportation (-13%), Metal Mining (-12%), Jewelry and Precisions Metals (-11%), and Transportation and Logistics (-8%).

Five top growing traded clusters are Aerospace Vehicle and Defense (100%), Performing Arts (16%), Upstream Metals (14%), Business Services (10%), and Metalworking Technology (9%).

The shares alone are not able to tell us the spillover effects, but once the cluster growth map is displayed, we can see more clearly which clusters grow with the similar rate especially to those value-chained clusters. Below is a more precise list of each city's leading specializations. They are different from the District formations; they give more details landscape of the cities.

Figure 33 City Leading Specialization Landscape.



Source: LQ map, Excel calculation

Twelve specializations spread out throughout all cities. The North is where central government and banks located, therefore, business services and distribution industries are well developed. IT dominates around Hsinchu Science Park and research institutes as the result of earlier economic planning from the 1970s. Production technologies provide machinery supports clustered in the middle of Taiwan. Production products go to South regions. The tourism industry is mostly concentrated where mountain ridges, east and south shorelines, and outer islands. The outer islands are small, therefore, have limited industries, and the specializations support the local lifestyles. Below is the detail list of specializations in each city (See Figure 34).

Figure 34 Taiwan's Specializations in Cities.

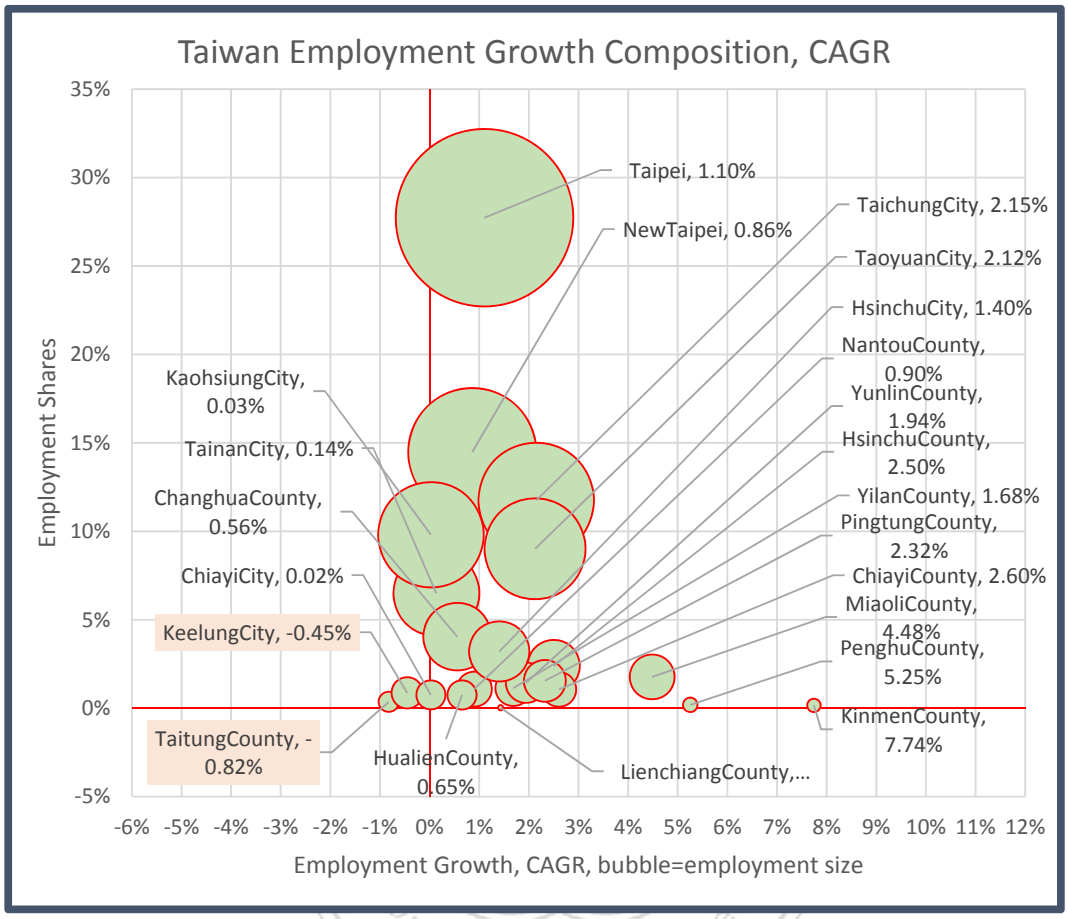
Cities	Traded Clusters	Local Clusters
New Taipei	Distribution and Electronic Commerce; Information Technology and Analytical Instruments;	Local Real Estate, Construction, and Development
Taipei	Business Services; Distribution and Electronic Commerce; Insurance Services	Local Food and Beverage Processing and Distribution; Local Financial Services; Local Hospitality Establishments;
Keelung	Business Services; Water Transportation	Local Food and Beverage Processing and Distribution Local Food and Beverage Processing and Distribution Local Hospitality Establishments Local Real Estate, Construction, and Development
Taoyuan	Information Technology and Analytical Instruments	
Hsinchu County	Information Technology and Analytical Instruments	
Hsinchu City	Information Technology and Analytical Instruments	
Miaoli	Information Technology and Analytical Instruments	
Taichung	Production Technology and Heavy Machinery	Local Health Services Local Real Estate, Construction, and Development
Changhua	Metalworking Technology; Textile Manufacturing; Upstream Metal Manufacturing	Local Health Services Local Hospitality Establishments Local Real Estate, Construction, and Development

Nantou	Construction Products and Services; Hospitality and Tourism	Local Food and Beverage Processing and Distribution Local Health Services Local Hospitality Establishments Local Real Estate, Construction, and Development
Yunlin	Construction Products and Services; Textile Manufacturing	Local Food and Beverage Processing and Distribution Local Health Services Local Real Estate, Construction, and Development
Chiayi County	Construction Products and Services; Food Processing and Manufacturing	Local Food and Beverage Processing and Distribution Local Health Services Local Real Estate, Construction, and Development
Chiayi City		Local Food and Beverage Processing and Distribution Local Health Services Local Hospitality Establishments Local Real Estate, Construction, and Development
Tainan	Upstream Metal Manufacturing	Local Food and Beverage Processing and Distribution Local Health Services
Kaohsiung		Local Food and Beverage Processing and Distribution Local Health Services Local Real Estate, Construction, and Development
Pingtung	Construction Products and Services	Local Food and Beverage Processing and Distribution Local Health Services Local Hospitality Establishments Local Real Estate, Construction, and Development
Yilan	Construction Products and Services	Local Food and Beverage Processing and Distribution

		Local Health Services Local Hospitality Establishments Local Real Estate, Construction, and Development
Hualien	Business Services; Construction Products and Services; Hospitality and Tourism	Local Food and Beverage Processing and Distribution Local Health Services Local Hospitality Establishments Local Real Estate, Construction, and Development
Taitung	Business Services; Hospitality and Tourism	Local Food and Beverage Processing and Distribution Local Health Services Local Hospitality Establishments Local Real Estate, Construction, and Development
Penghu	Business Services; Construction Products and Services; Hospitality and Tourism	Local Food and Beverage Processing and Distribution Local Health Services Local Hospitality Establishments Local Real Estate, Construction, and Development
Kinmen	Business Services; Construction Products and Services; Food Processing and Manufacturing	Local Food and Beverage Processing and Distribution Local Health Services Local Hospitality Establishments Local Real Estate, Construction, and Development
Lienchiang	Business Services; Construction Products and Services; Hospitality and Tourism; Water Transportation	Local Food and Beverage Processing and Distribution Local Hospitality Establishments

A Taiwan's employment growth of each city is calculated to find out which city is growing and which is declining during the financial crisis. Below is the map for Taiwan's employment composition.

Figure 35 Taiwan's Employment Growth Composition.



Source: calculation of Census data from *Taiwan National Statistics Bureau*

Taipei City has the largest employment among all the cities with the second highest pay. It is big enough and dense enough for the importance. This is where political-social-economic capital sits and all the banks are headquartered. It is a financial center for all businesses, and international negotiations are mostly done here. The high-density city provides a close distance and the convenience for business doing. The smallest employment population is in Lienchiang County that is an outer island.

From Figure 35, two cities are losing jobs, which are Keelung (-0.5%) and Taitung (-0.8%). Two cities have high growth of more than 5%, and they are smaller cities of Kinmen and Penghu; these cities have many tourists from China due to ECFA open trade policy. Miaoli is the city that has the fastest growth on Taiwan. Edward Glaeser suggests that important knowledge spillovers are more likely to happen between industries rather

than within the industries (Glaeser, Kallal, Scheinkman, & Shleifer, 1991; Jacobs, 1970). On the contrary, Miaoli is an evidence of the spillovers effects on the same industry but in the adjacent cities due to the saturation effect. Miaoli is enjoying a 4.5% job growths, and this is an adjacent city of Hsinchu Science Park. IT is the dominated industry in Miaoli, thus spillovers from Hsinchu area. Additionally, five cities have 2% to 3% job growth, and they are Taichung, Taoyuan, Hsinchu County, Pingtung, and Chiayi. These cities have the production support industries. Other cities have a slow growth less than 2%. The major metropolitans are still growing employments. Despite the GDP had a sharp drop in the year of 2009, a big part of Taiwan has recovered from the external shock with the exception of Keelung and Taitung.

Once the growth rates of each city are identified, the next is to find out which clusters in each city are doing better and which are not. The specialization provides the concentration of clusters in that particular city. In other words, we would like to find out which clusters made the best contribution, and which one has lost the momentum and needs help. The more specialize the cluster, the more important this specialization is for this region, and also the nation is more dependent on this region for the product or service deliveries. The specialization calculation is based on Location Quotient (LQ). The specialization provides the landscape for the concentration of the clusters and its importance.

In order to find out the clusters mapping in each city, three sets of data were calculated, employment size, employment shares, and LQ calculated based on the employment numbers of the city. The three data were used to draw a bubble map to represent the position of each traded cluster with the following setting:

X-axis = LQ

Y-axis = Employment Shares in %

Bubble Size = Employment Size

By drawing the map, the city's cluster landscape is immediately shown. The following analysis gives different categorization by looking at the map:

Figure 36 Employment Shares and Specialization Impacts.

Employment Shares	LQ <1	LQ >=1	LQ >=2
Shares <5%	No significance	A specialized cluster but small regional impact	Highly specialized cluster with small regional impact
5% <= shares< 10%	Some regional employment impact	A specialized cluster with some regional impact	Highly specialized cluster with high regional impact.
Shares >=10%	High regional impact but not specialized	A specialized cluster with some regional impact	Highly specialized cluster with high regional impact

Job matters, employment growth is a very important indicator to see if the cluster is expanding and active, reaching its capacity at stagnate, or losing competitiveness in decline. The employment growth rate in a city is calculated as follows:

Figure 37 employment growth rate calculation.

$$Employment\ Growth\ Rate = (cluster\ employment\ size)/(total\ employment\ size)$$

To draw a Specialty and Growth Map, use the following dimensions:

X-axis = LQ

Y-axis = Growth Rate %

Bubble Size = Employment Shares

The implications of job growths and the weight of specializations are listed below:

Figure 38 Employment Growth and Specialization Relations.

Employment Growth	LQ<1	1<=LQ<2	LQ>=2
Declining	No significance	Specialized cluster is losing competitiveness in the city	Highly specialized cluster is losing its momentum
Stagnate	No significance	Specialized cluster is stable	Highly specialized cluster is stable
Growing	May become a specialized cluster	Specialized cluster is competitive	Highly specialized cluster is winning
Growing and over 5% shares in the city	An important regional cluster may become an specialized cluster	Specialized cluster is competitive and is regionally important	Highly specialized cluster and is regionally important
Growing and over 10% shares in the city	Highly important regional cluster	A dominated, competitive, and specialized cluster	A dominated, competitive, and highly specialized cluster

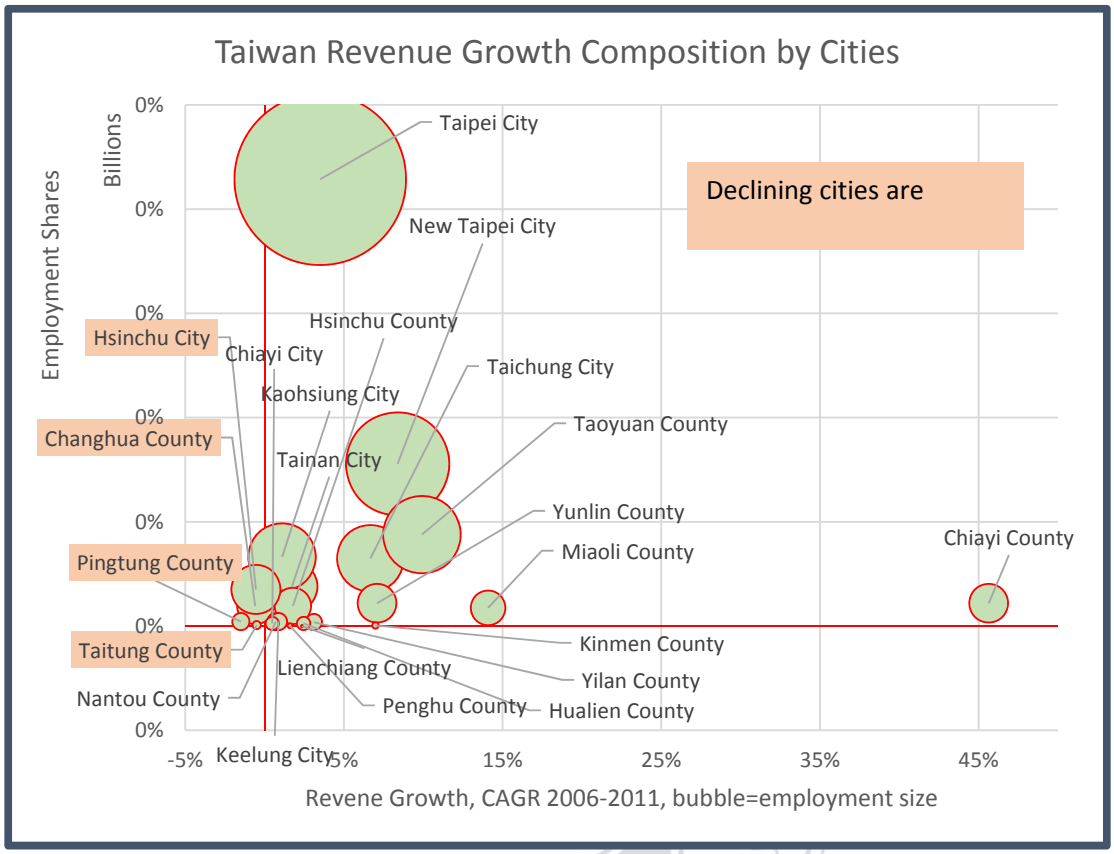
7.3.2. Revenue Factor

Revenue is a driver to the growth change. Schumpeter's Business Cycle theory puts user demands (Schumpeter, 1939) as the first priority in the start of the cycle for a market-driven economy. It is a main driver for the employment and wages. Rising revenue will cause higher employment rates depending on the labor pool supplies. For example, if certain clusters require some special skills and lack of trained manpower, the employment growth can still be low, but wage will rise due to higher labor demand. Also, it is possible that the labor pool has not reached its maximum capacity. Nevertheless, revenue is good gauge for business growths and expansion. A steadily growth on revenue is a good sign, but if the growth rate fluctuates, it will cause businesses to hold back due to the uncertainties.[30]

Below is Taiwan's Revenue Growth Composition by Cities:

[30] This was validated by Waterson Manufacturing operation manager.

Figure 39 Taiwan's Revenue Growth Composition by Cities.



Source: *Taiwan National Statistics Bureau*

Three cities have very high growths - Chiayi County (over 45%), Tainan City (over 25%), and Miaoli County (Over 10%). Since revenue is an independent variable, one would research the strengths of the growth. Is it the spillovers from the adjacent city such as Miaoli from Hsinchu, or is it a policy that has infused a large investment or program to encourage the expansion? This prompts to look into the city cluster level individually to find the higher growth clusters and its employment size to see any potentials for expansion to form cluster initiatives. Similarly, the same method will be used to look into the declining cities and find the weakness for policy improvements or business environment upgrades.

The revenue declining cities are Pingtung (-1.5%), Changhua (-0.6%), Taitung (-0.5%), and Hsinchu (-0.5%). We shall further look into which industries are not doing well in those cities.

Similar to the employment growth map, the setup for the Revenue Growth and Specialty Map is:

X-axis = LQ

Y-axis = Revenue Growth

Bubble = Revenue Shares

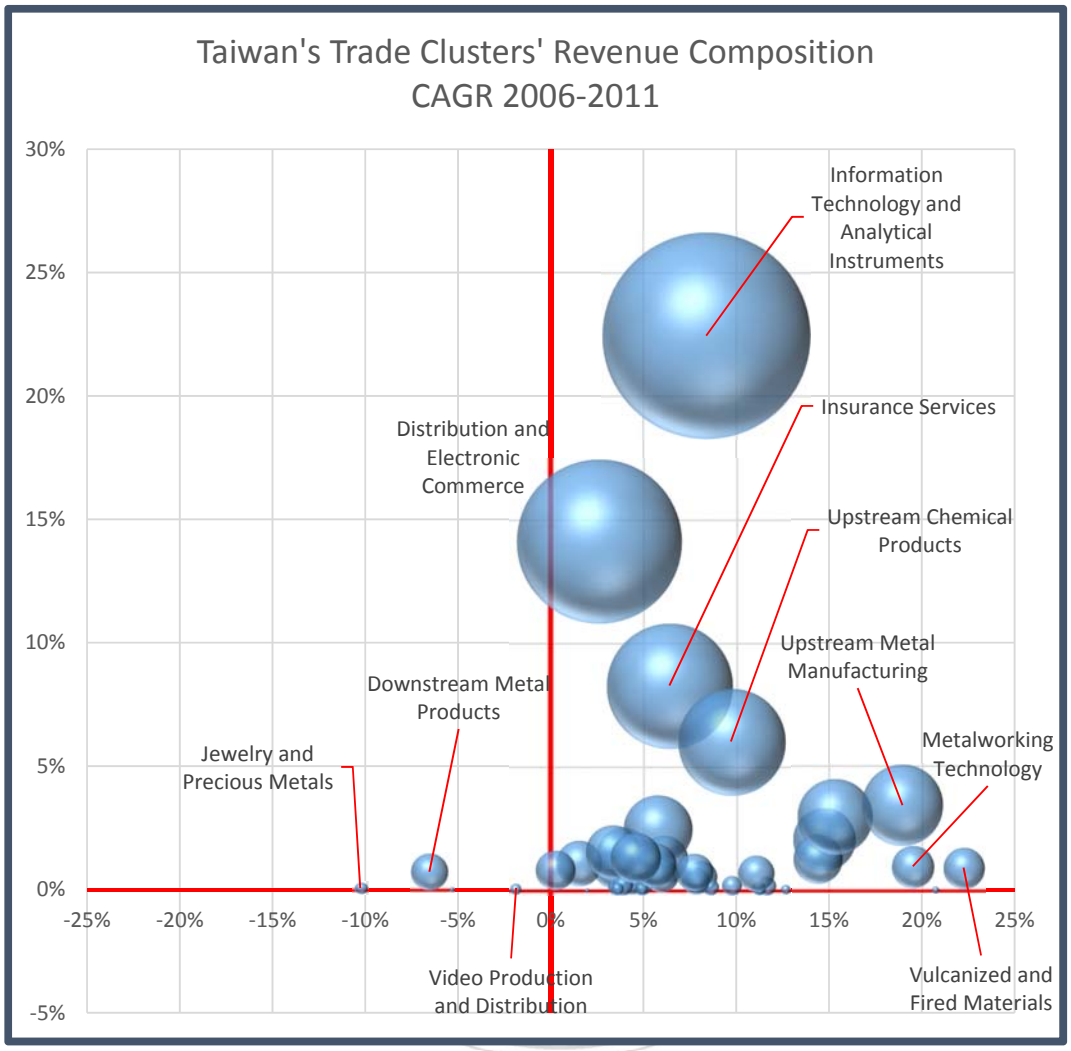
The implications of revenue growth and the weight on specialization can be as follows:

Figure 40 Revenue Growths and Specializations Relations.

Revenue Growth	LQ <1	1<=LQ >2	LQ>=2
Declining	No significance	Specialized cluster is losing business	Highly specialized cluster is losing business
Stagnate	Regional stable	Specialized cluster is stable	Highly specialized cluster is stable
Growing	Regional cluster has more orders.	Specialized cluster has more orders	Highly specialized cluster has more orders

Below is how Revenue changes in Traded clusters during 2006 and 2011. Only three clusters declined in the revenue composition, and the Downstream Metal Products cluster is that the bigger shares. The Distribution and Transportation clusters are up on revenue.

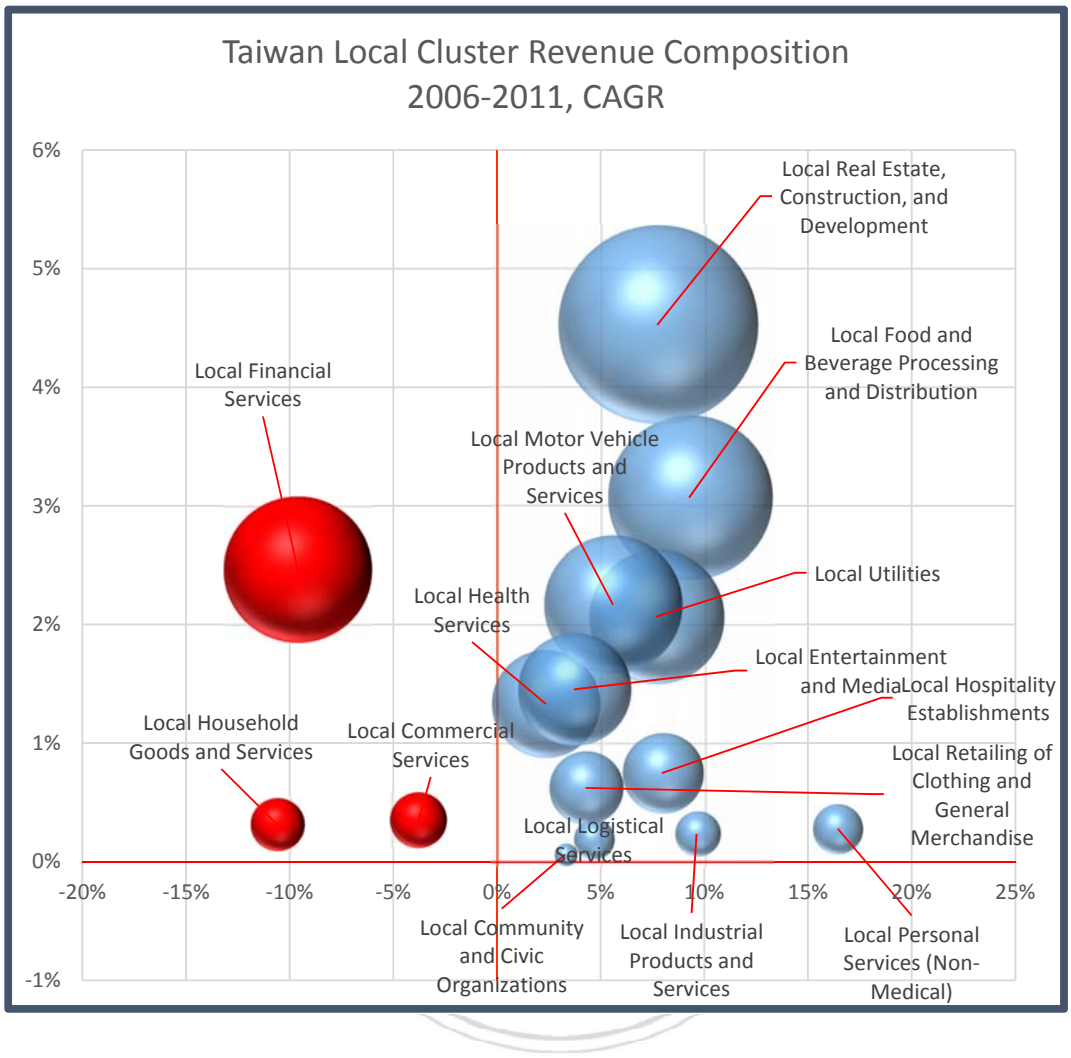
Figure 41 Taiwan's Traded Clusters' Revenue Composition.



Source: *Taiwan National Statistics Bureau*

Below is the local cluster revenue composition.

Figure 42 Taiwan's Local Clusters' Revenue Composition.



Source: *Taiwan National Statistics Bureau*

7.3.3. Wage Factor

Wage indicates how well people are doing. Not all clusters have the same average wages. Some clusters require more technical skills that drive a higher wage. The most desirable cluster is the highly specialized, high wage, and largely agglomerated clusters, such as Italian, shoes, French wine, Silicon Valley's high-tech and Taiwan's IT clusters. Wage is also a strong indicator of manpower supply. When there is an oversupply of manpower, that will forbid wages to rise due to employment competition. Often there is spillover

effects from one cluster to another cluster, providing more opportunities for job change and wage gain (Glaeser et al., 1991), but wage gain is not the same as the business gain. Business gain can trigger the wage to rise due to shortage of manpower either by fast growing cluster with higher labor demand, or there are new technological innovations require different set of skills to fulfill the job. The average wage here is calculated by taking calculating the CAGR from the wages of 2006 to the wages of 2011. Below is Taiwan's average wage ranking of Traded clusters and Local clusters.

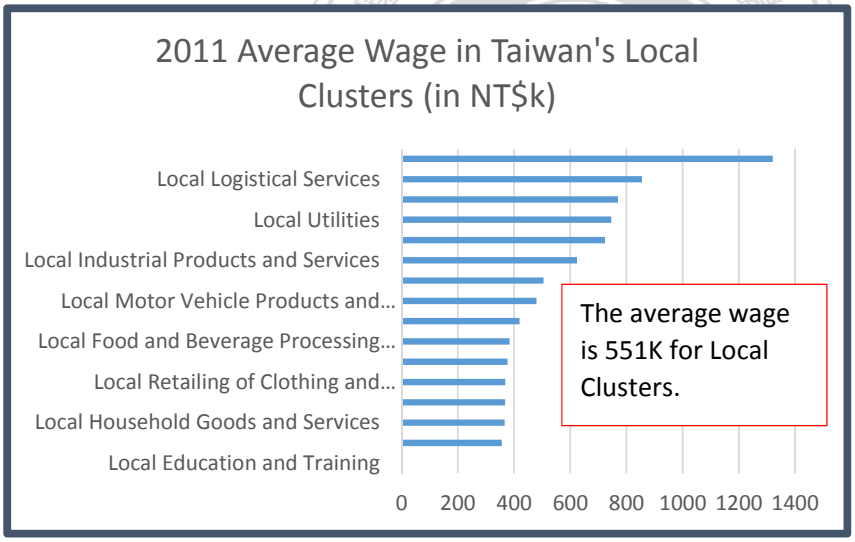
Figure 43 Annual Wage Ranking of Taiwan's Traded Clusters.

Source: *Taiwan National Statistics Bureau*

Top paid Traded Clusters are:

1. Oil and Gas Production and Transportation
2. Upstream Chemical Products, Financial Services
3. Financial Services
4. Communication Equipment and Services
5. Information Technology and Analytical Equipment
6. Water Transportation
7. Environmental Services
8. Biopharmaceuticals
9. Trailers, Motor Homes, and Appliances
10. Downstream Chemical Products

Figure 44 Average Annual Wage of Taiwan's Local Clusters.



The top 3 Local paid clusters are:

1.Local Logistical Services

2.Local Utilities

3.Local Industrial products and Services

Source: *Taiwan National Statistics Bureau*

The average wage between Traded and Local clusters are not that far apart. Taiwan has a GINI factor of 33.8 (2012s)[31] which explains short gap. The Traded Clusters with better and above average pays are Oil and Gas Production and Transportation, Upstream Chemical Products, Financial Services, Communication Equipment Services, Information

[31] https://en.wikipedia.org/wiki/List_of_countries_by_income_equality

Technology and Analytical Instruments, Water Transportation, Insurance Services, Transportation and Logistics, Environmental Services, Biopharmaceutical, Trailers Motor Homes and Appliances, Downstream Chemical Products, and Marketing Design and Publishing. The Local Clusters with better and above average pay are Local the Financial Services, Local Logistical Services, Local Health Services, Local Utilities, Local Entertainment and Media, and Local Industrial Products and Services.

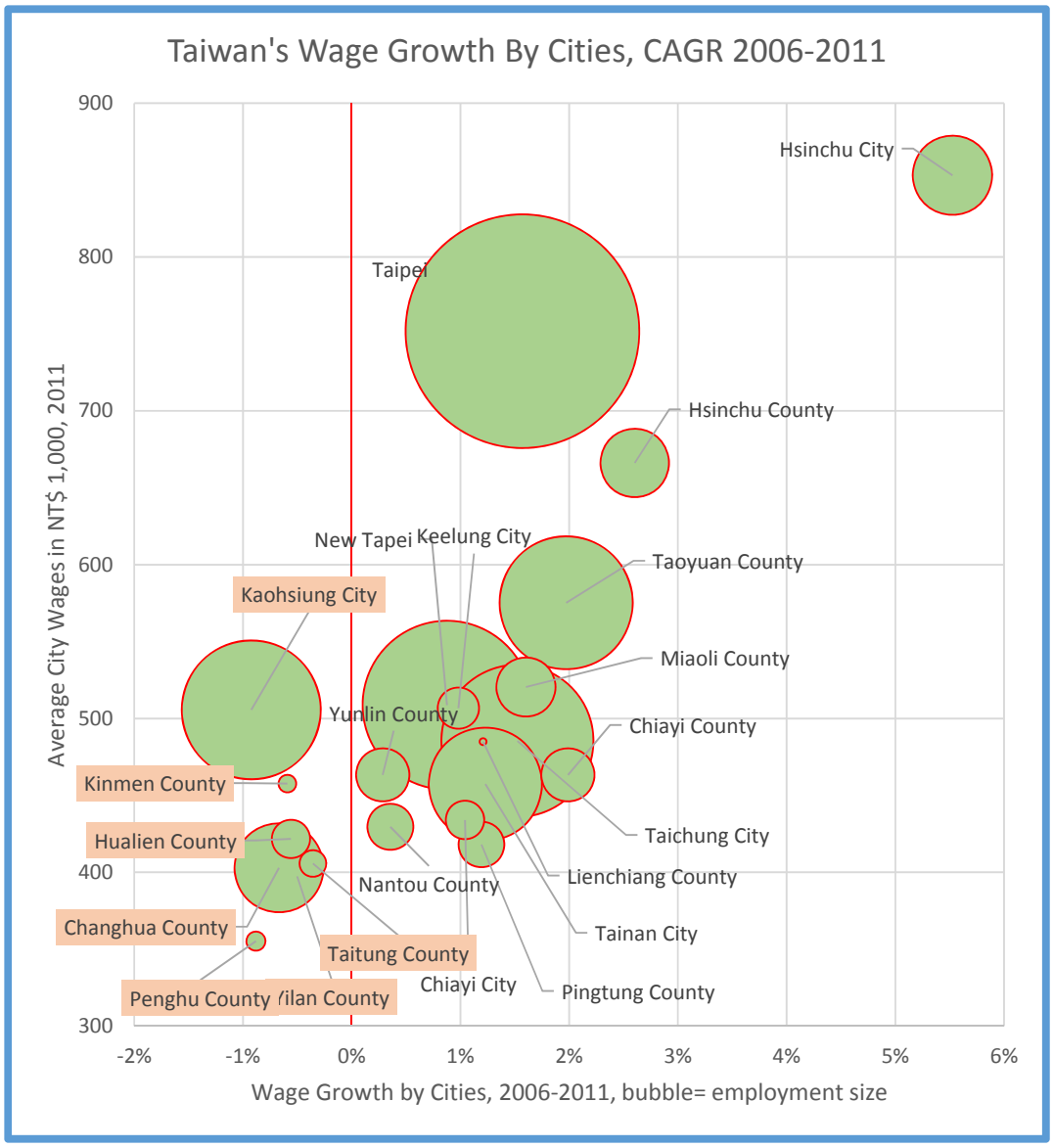
How have these clusters weathered through the financial crisis? The three top-paid clusters are Oil and Gas Production and Transportation, Local Financial Services, and Upstream Chemical Products respectively, and they are all smaller clusters of less than 2% of all workforce. Two faster growing Traded Clusters are Upstream Metal Manufacturing and Metal Working Technology, and these clusters are 2% or more. The three most noticeable declining clusters (highlighted in red in Figure 47 Taiwan's Cluster Composition are Distribution and Electronic Commerce, Transportation Logistics, and Downstream Metal Products with losing momentum after the 2008 financial crisis. The largest cluster of Distribution and Electronic Commerce of 10.09% employment shares are losing 0.61% of the employments over 5 years during the financial crisis going.

Wages depends on the revenue throughput and labor supply pool to determine its ups and downs. Cities' wage differences can tell how productive the region is. The higher wages normally demand for more knowledge or skills; therefore, job training is important for the supply of labor pool. The Hsinchu Science Park has two first-class Universities nearby with a government supported research institute to supply the knowledge training, and there are vocational colleges nearby the cities that contributes to the technician level of job workers for mass production's labor supply.

The middle management for the knowledge intensive industry is crucially important because the managers not only have to manage the production process, they also have to understand the nature of the technology and how to apply the best production equipment for the mass production. Lots of tuning needs to be done when a design in transferred into production floor. Taiwan's OEMs win on modulized-production equipment. For a new designed electronic consumer product, normally takes minimum a year to design and test out the production line, it can take Taiwan's OEM three months to modify a production

to retrofit the line into a newly functional production line, and it does not tolerate the production quality and testing. This production strategy without the knowledge of Production Technology and Heavy Equipment cannot be easily done. Part of Taiwan's IT success is built on this production strategy. On wage composition among cities:

Figure 45 Taiwan's Wage Growth by the Cities.



Source: *Taiwan National Statistics Bureau*

Hsinchu City ranks the highest pay and growth cities among all. The Hsinchu Science Park, two first-class Universities, and a semi-government research center provided the

excellent business environment for the success of knowledge-intensive IT Cluster. Different from the Silicon Valley high-tech cluster, Hsinchu cluster provides the knowledge and research on Production Technology and high-skill trained labor to support Silicon Valley's innovative designs for consumer markets. The customers for Hsinchu are high-tech product designers, and Silicon Valley's customers are electronic consumers.

The worst wage declining is in Kaohsiung City with fairly sizable employment raking the 4th. Changhua is another city of a concern with its employment size and wages decline. It is worth looking more deeply into why Kaohsiung and Changhua is taking a toll on wage decline. What clustered industries primarily drives these areas and compared to the world trade data to see what other areas are rising? Taiwan overall, the North region is stable on all three growths. Taitung and Pintung need more attention to find out why it did not resist the external shock. Tainan is doing very well on all three growths, and this is worth to see what is the competitive advantage to be agglomerated. Miaoli obviously enjoyed the Hsinchu's spillovers.

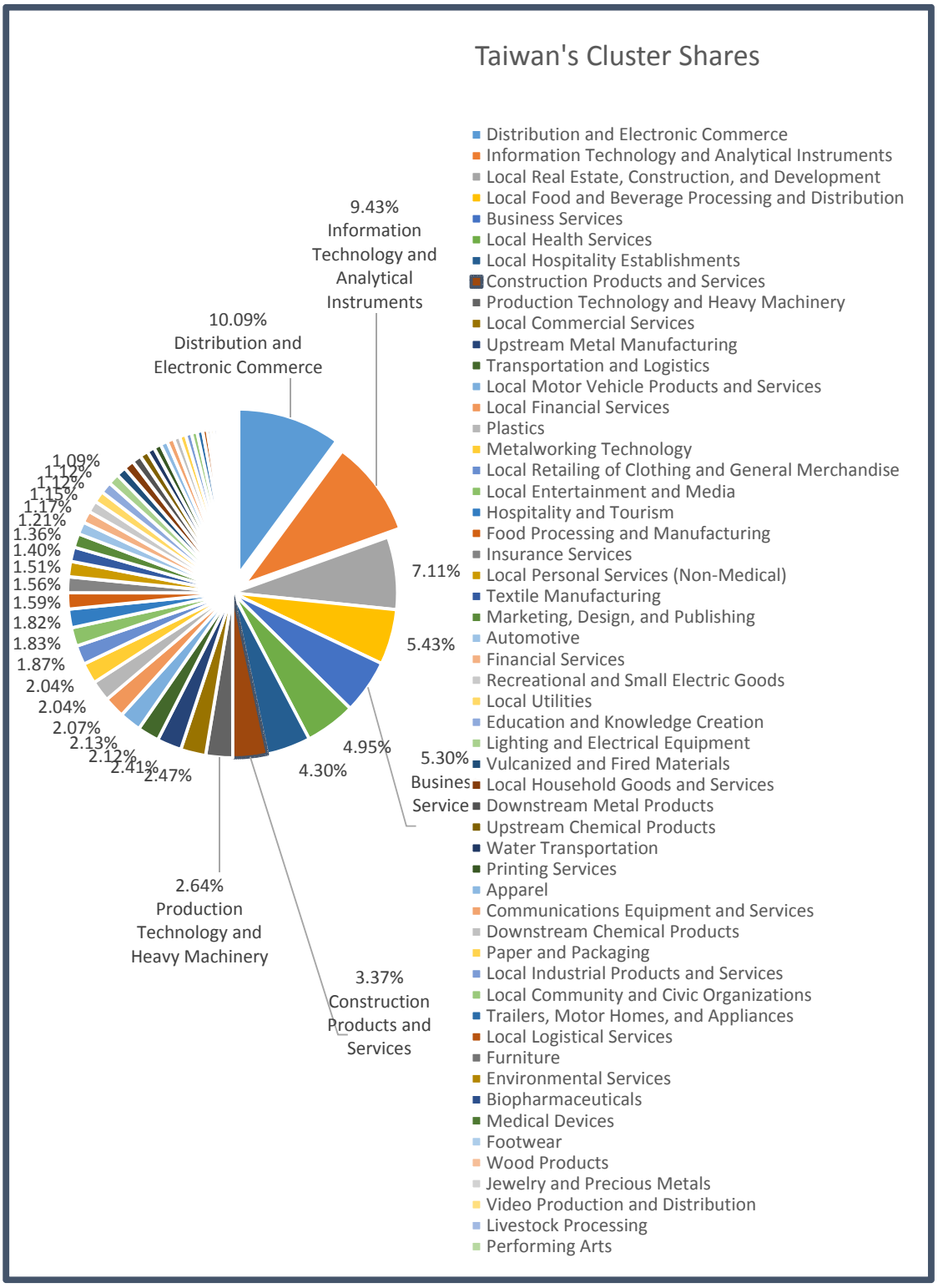
8. Taiwan's Economic Dynamics

Which clusters have better sustaining power? Which clusters need help? Again, by looking into the employment growths, we can identify how well are these clusters performing economically. Since we have learned that revenue is a driving factor for employment, and lack of suitable human resources can cause employment to drop and wage to rise. We can run maps for all the cities and districts to see which clusters are facing the most challenges and which clusters are on a growing track.

8.1. Taiwan's Cluster Shares

First we will find out Taiwan's cluster shares. Figure 46 shows a pie-chart of the shares of all clusters. The two 10% specializations, Distribution and Electronic Commerce, and Information Technology and Analytical Instruments, are about 10% shares each which has the most agglomeration over the years. The next cluster is the Business Services with around 5% shares. Therefore, we define that clusters over 10% shares are considered dominated clusters in Taiwan.

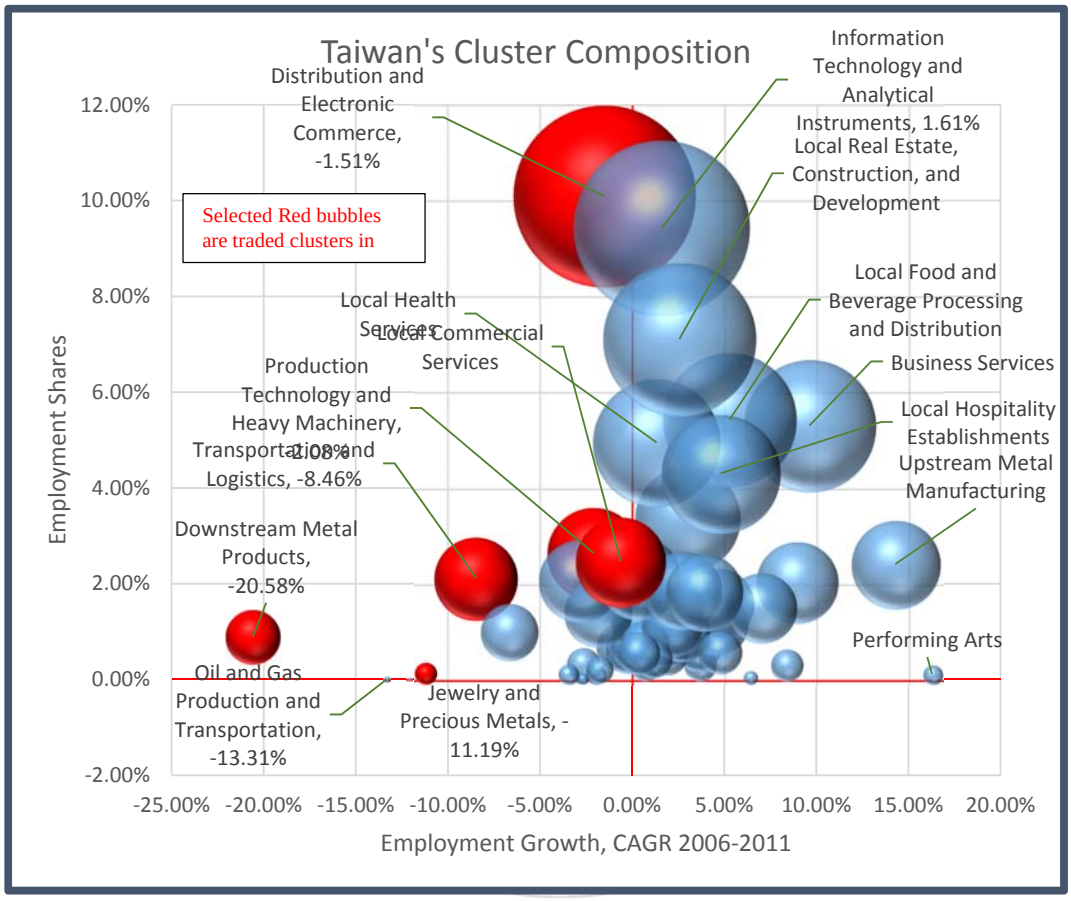
Figure 46 Taiwan's Clusters' Shares.



Source: *Taiwan National Statistics Bureau*

Taiwan's full cluster composition with employment growths are calculated and mapped as follows:

Figure 47 Taiwan's Cluster Composition.



Source: *Taiwan National Statistics Bureau;* ** The Footwear cluster was added after 2011 in Taiwan's National Statistics; therefore, the growth is treated as an outlier from the analysis, and the cluster is quite small.*

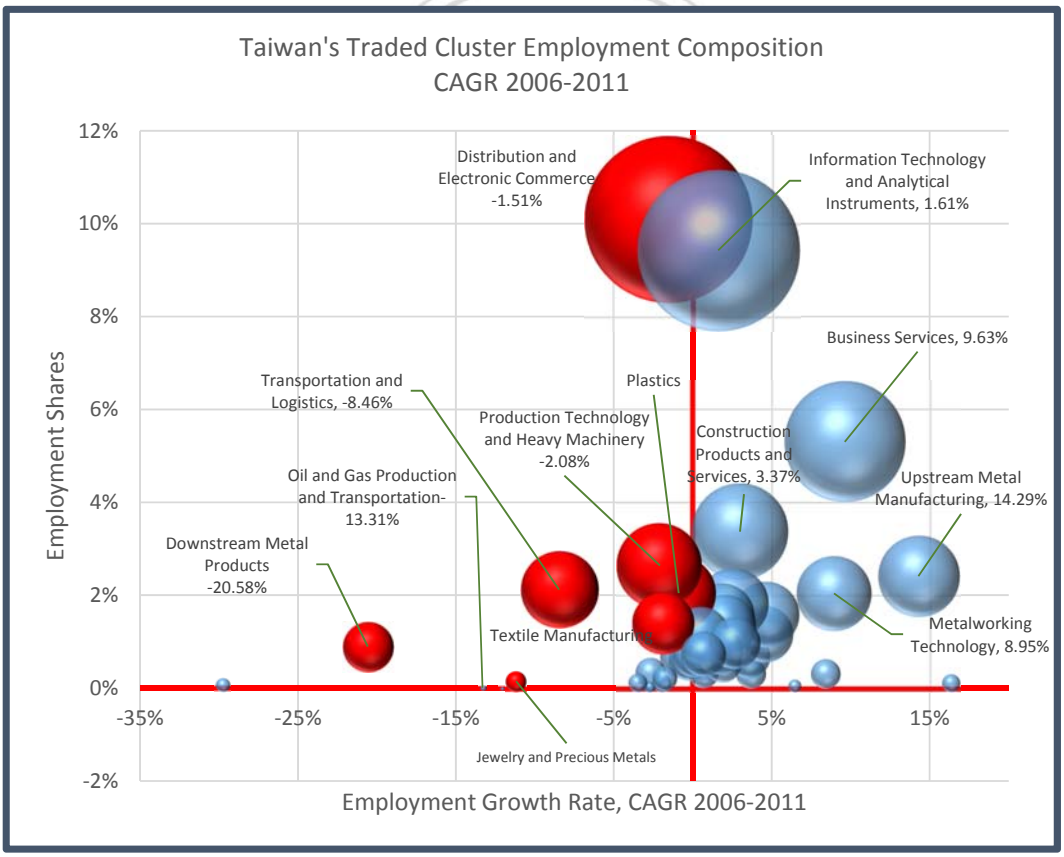
Figure 47 provides an overall picture of Taiwan's productivity. The aerospace Vehicles and Defense is a cluster with a fast growth but the cluster is small in size and had no activities in 2006 indicating the cluster is at the initial stage. The larger clusters are Distribution and Electronic Commerce (10.09% shares), Information Technology and Analytical Instruments (9.46% shares), Local Real Estate, Construction and Development (7.12% shares), Local Food and Beverage Processing and Distribution (5.38% shares), Business Services (5.3% shares), Local Health Services (4.9% shares), Local Hospitality Establishments (4.26% shares), Construction Products and Services (3.36% shares),

Production Technology and Heavy Machinery (2.63% shares), Local Commercial Services (2.46% shares), Upstream Metal Manufacturing (2.4% shares), Transportation and Logistics (2.12% shares), Local Motor Vehicle Products and Services (2.12% shares), Local Financial Services (2.08% shares), Plastics (2.21% shares), Metal Working Technology (2% shares) which are over 2% shares significance.

The map is further separated into Traded Clusters (see Figure 48) and Local Clusters (see Figure 50) based on the newly defined cluster codes (Appendix - Taiwan Clusters Code Definitions).

8.1.1. The Traded Clusters

Figure 48 Taiwan's Traded Clusters Employment Composition.



Source *Taiwan National Statistics Bureau*

From this map, we clearly see something is in an alarming stage. The Distribution and Ecommerce, the largest cluster of all is at a declining pace. Although the decline is small

at -1.51%, the employment size of the cluster is the largest cluster (10%) among all clusters, which can mean a big upset. The other declining clusters such as Transportation and Logistics are the supporting industries of all distributions for products, which may have been impacted by the drop of the production industries. This directly impact the North district cities, New Taipei and Taipei, with their specialized employment. The north is a highly populated area and business centers. It will have a full impact to Taiwan economy. Furthermore, the Downstream Metal is an important production product category, which has a 21% drops, and its complementary industrial cluster of Production Technology and Heavy Machinery has declines of 2% which gives a clear indication that the hardware production businesses are facing severe competitions. The next question one would ask is which cities are directly impacted and why? What should people do to overcome the declines? There are two choices, knowing the industry is declining in a fast rate, and affects the supporting industries to drop. One choice is to ignore it and let it die. Another choice is to improve the business environment and make it competitive, so that it wins back the businesses it has lost. Collectively in these clusters, there are more than 10% of the workforce facing hardship due to employment decline. Some workers found jobs in other clusters, and some remained unemployed. As part of MOC framework[32], several interviews and site visits to the Machinery and Production and Downstream Metal Products companies reveals the following issues[33]:

Over 90% of Machine Tool companies are small businesses. It is difficult for them to acquire public funds from bank loan or private investments if they want to upgrade their businesses. This is a capital-intensive industry. In order to update the business environment, the cost of up-to-date automation equipment may take a twenty-year business loan to payback. Small businesses with limited capital on-hand need a smooth policy to allow them to grow.

Most investors nowadays are looking for fast return deals. Equipment heavy capital takes too long for their expected quick returns. Also, the return margin is too small for their

[32] A Microeconomic of Competitiveness course is offered at Harvard Business School taught by Porter, Ketels, and Ramirez-Vallejo in Winter 2015.
[33] The Machinery Association, interviewed on August 4th, 2015 indicates the government funding issue to the SMEs.

high apatite. At a Machine Tool workshop in Taichung, the keynote speaker talked about how difficult is to convince the government to create an industry upgrade policy to help the local owners, especially on the basis of business loans.

Most small businesses in the industry are family run, and some owners are at the retirement age. First, it is difficult for the business owners to find the owner replacements or to sell the companies. Second, it is even difficult to hire a manager to handle the operation. Not so many are willing to come to an outdated factory to work. The production type of factory takes skills, knowledge, and experiences to phase in. Provided the businesses are mostly in a rural area, most of young people prefer to live in the metropolitan for their social activities, and even trainees are hard to be found.

Vocational training used to be very popular in Taiwan in the 1970s through 1990s. Due to the change of education policy in 1994 to liberalize the education system (Hallinger, 2010, p. 8). Most vocational schools had been converted to Colleges and Universities over the past 20 years. The old technical masters are retiring without trained technicians, and the industry is facing severe labor shortages.[34]

Orders fluctuate due to competition. Customers are not always loyal when it comes to price war. Other related industries such the glass industry has lost a big customer, Ikea, to China's low pricing in 2009. The industrial cluster, already small, got together, formed a coalition taking orders collectively, and distributed the orders to different specialties such as glass with metal framing, glass with wood products, glass with Alumni, so the whole village survived through the down time. They have realized one thing. Price war is not a strategy, which echoed Porter's theory. Instead, they insisted on improving customer services for restocking and guaranteed for manufacturing returns. In 2011, they won back Ikea's orders due to the service quality. Cut price is not a strategy, and it can hurt you. The fluctuations of orders deter manufacturers to invest capital-intensive equipment.[35]

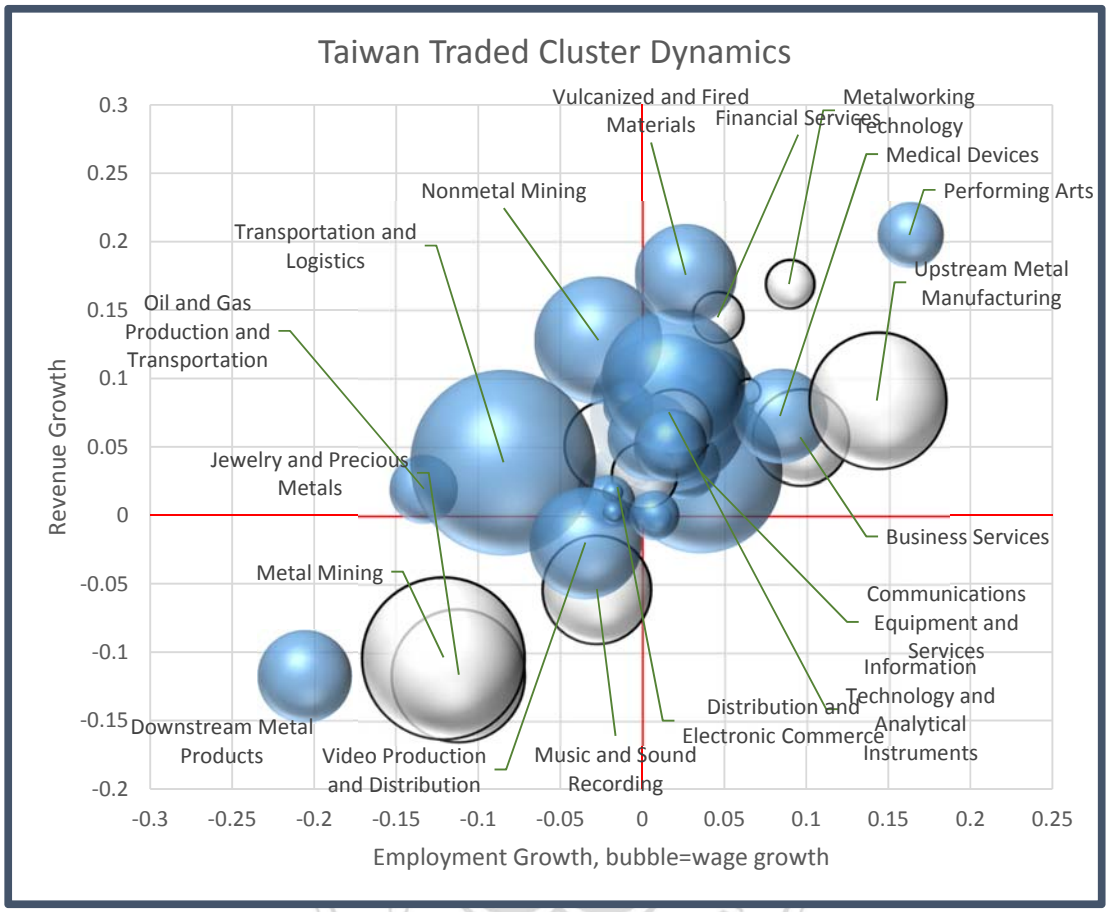
Another issue which hit the socks industry hard was the Free Trade Agreement signed by the US and Korea. Overnight, Shetou socks manufactures lost one-third of their orders in

[34] Interviews by Waterson Company in Yunlin. July 2015 and Feb. 2016. Also interviews in 2013, 2014.
[35] Data from Chiahui Chen, IEK, ITRI.

the whole region. It devastated the manufacturers. Some companies recovered by specializing their products into sportswear or using organic materials. Some closed the businesses. Through the interviews in the area, one company focus on specializing sport's stockings who could not convert the manufactory into larger businesses due to the current factory site did not have a building permit. Many factories were embedded in their farming residents with a space built-out. The place was built 30 years ago without a permit. In order to obtain a business loan, it needed to show that the factory is a safe facility with a building permit. Without proper permits, the company could not expand. They either had to move-out, or rebuilt the factory. There was no interim solution provided, and these factories were facing immediate challenges to upgrade or downgrade due to severe oversea competitions. Taiwan, without a proper international identity, lost deals with numerous unfair competitions based on political marginalization. Taiwan makes most of its national balance from trade surplus. Taiwan ranks 5th in the trade surplus countries behind the Netherlands in 2015. It used to be fourth, but Taiwan is gradually losing its sustainability mostly due to the unfair trade status and losing international competitions. The impacts on economics are caused by politics largely.

Recently, Taiwan is relaxing its labor law to allow migrant workers to work longer and obtain residency. The law is still very protective of the locals. One of manufacturing owners in the interviews reveals that despite the management position is paying much higher than the regular level, the owner is not able to find middle management for a long time. One of the reasons being most local Taiwanese do not like to work with migrant workers. "They don't like to lower their social status by working with migrant workers." quoted by the owner. These are common problems in the manufacturing area. "We also have foreign brides, and the locals don't even want to work with them because that makes them feel foreign." continue with the interview. In this case, education and labor training have been a conflict by the Taiwan's Confucians' "class" philosophy. On top of it, young people nowadays do not like to get their hands dirty. Jobs require hard labor with skills are being avoided by most young people despite the pay rate.

Figure 49 Taiwan Traded Cluster Dynamics.



Source: *Taiwan National Statistics Bureau*

Taiwan is not the first country to face the production hardship. Germany faced the similar challenges before, thus, triggered the Industry 4.0 Initiative to solve Germany's productivity problems. With a lower birthrate and an aging society, Germany has been facing the same kind of problems. A decade ago, German government initiated a high-tech strategy policy in 2006, and publically announced the initiative in the 2011 Hanover Show to upgrade factory environment and automation, they implemented a sophisticated industry upgrades into today's robotic automation and environmental rebuilt (Springer, 2015). Job training was designed through high school apprenticeship. Safety work clothes and air conditioning were provided. Robots replaced hard labor works which were done by human hands before.

I interviewed Andrea Springer[36], asking him what Germany's progress is for Industry 4.0 and their next step. Springer replied "No further initiatives are found on this title." It is an initiative with an over ten years of rebuilt and upgrades. They are moving on with their normal businesses. Now they can compete better in the world with the best equipment and humane environment. Springer toured Taiwan's local factory and commented: "This would be an illegal and dangerous working environment in Germany. It will be closed down immediately." People are inhaling heavy metal particles in an overheated wax molding tooling shop. The air is full with dust and haze in a no air-conditioned room. I held my breath not wanting to breath in the dusty workroom and left the room in less than a minute. I cannot imagine people working in that room for days and even years.

Conducting the fieldwork was eye opening for me. Without seeing the real situation, the research would be only half true. The numbers become real after seeing the true conditions. Factory owners are still facing the same challenges every day. They try to get orders from oversea customers, invent new ways to produce with higher quality and lower costs, and design new products to meet the market demands. Many of them do not speak English, but they travel all over the world to find businesses. Trade show is especially important for them to present their products to international buyers, or find new products to imitate.

One owner said "When they see me walking through their [westerners in a tradeshow] booths, some of them would wave their hands at me and tell me to leave. I was not welcomed because they know Taiwanese or Chinese like to copy their designs. I find ways to copy it anyway, and I can design something even better than theirs… I don't like to go to those 'foreign' tradeshows because I don't speak English well, so I quit the frontline business and stay as an OEM manufacturer… What I do today is to focus on one product but make many different versions and qualities to supply to anyone and everyone who needs this type of components…I make steel shocks for bicycles only." The owner took me to his show room, and I saw thousands of the stainless-steels components. All of those were parts of bicycle shock system. It was a real educational tour for me.[37]

[36] A German scholar who has done research on Industry 4.0.
[37] Interview in 2013 summer at Changhua, a student of mine in Business English class.

This owner came to my Business English class. He barely spoke any English, but his annual revenue is around US$15 million with a growing rate of 10% each year for the past 35 years. He is over 60 years old and is getting ready to retire. He owes no loans, and banks love to ask him to have tea breaks [to sell him bank loans]. He has a factory built 35 years ago on his father's rice field. The factory has no permit; therefore, he has no collateral for any loans to upgrade his factory. He has about 29 migrant workers in his factory, mostly from Indonesia. He said, in 2017 he will run into worker shortage problems because Indonesia will stop sending migrant workers out of country, and I will lose all my migrant workers. Indonesia is having two-digit economic growths and has plenty of work for their own citizens. The owner also has a larger factory in Shanghai. The business over the past fifteen years has been growing and is earning five times more revenue than in Taiwan. I asked why he does not move to China instead and still keep his business in Taiwan, especially, since China's factory is so successful. He replied: "Taiwan is my home. My father is old but still working in the rice field. This is where my wife, my children, and my grandchildren live. I am comfortable here as my root. I do not want my family to move to the Communist China because we are not Chinese. We are not local there. Where I was born is where my home is. This is the reason why I keep my business healthy and still growing here. One day, I will retire and come back to maintain my small business at home. I have my daughter working in the company now. My son is in China running my bigger business because that is where a young man should be, the bigger place with bigger challenges. My daughter should stay close to me because when I retire, she will take care of me. Also, I have two grandchildren nearby, and they are my real joy. I have more fun with my grandchildren than anything else now." He opened up three different bottles of whisky at eleven o'clock on the Saturday morning and started "wine tasting." He said "For the westerners, they drink whisky slowly. In China, whisky is down poured." This concluded the interview, a memorable interview.

These field-interviews are only a small part of the story. From Taiwan's Traded Cluster map (Figure 48), there is a growing Cluster, Information Technology and Analytical Instruments (IT). It is growing at an increasing rate of 1.6% during the financial crisis time. And on the left of that bubble is the Distribution and Electronic Commerce Cluster which is declining at a rate of 1.5%. The divider line is the 2008 within the traded-cluster

bubble map. The map presents a reality. The reality is telling Taiwan's people that a major industry is declining despite another equally big cluster is growing. It either needs innovation for an industrial structural change or let it develops naturally. Perhaps it is ready for a disruptive innovation like Industry 4.0, or it will be replaced by other international competitors, especially to the Southeast Asian regional neighbors like Indonesia or Vietnam. With a cluster employment size close to 10% of national shares, it is very important to look into the solutions. On the growing side, we see the IT Cluster is on demand on the rise despite the external shock, especially the Business Services, Metalworking Technology, and Upstream Metal Production clusters are rising quickly. This posts opportunity for these clusters to expand with initiatives if strategy is set with clear goals for growth. The map is showing a business dynamic shift from production business into service businesses, from hard to soft, from machines to people. If Taiwan is letting go completely at a free fall, that is where it will land, toward a business service oriented information technology world. At least, that is told by the numbers in the harsh period. Thanks to the financial crisis, the split was cracked open by the external shock. This is not to say that Taiwan is fading out with its production ability. On the contrary, Taiwan has become better and stronger production floor for very high quality electronics consumer products, especially in the Upstream Metal, and Production Technology clusters' growth. When this happens, part of very matured and sophisticated manufactures will remain in the top of the pyramid and being competitive, who have built the business knowledge and environment to overcome challenges and rise to the top. Their customers demand for very high quality products like Apple. One of the hand-tools company interviewed, they have invented new machinery to speed up production by 10 times; it even surprised their American customers.

Furthermore, the cluster supporting industry shares a very strong and cohesive value-chain. They migrate in packs wherever they decide to develop in the next location. The earlier migration was from Taiwan to China. Now that Southeast Asian is on the rise, many have already migrated to Vietnam and Indonesia to find the next location to produce their products. These over long period of collaboration and partnership within the value-chain are hard to break, and they carry the name for success. Their specialty is being the best of OEM suppliers. Here we name them the "Migrant OEM". They go to

other nations to build the OEM clusters. No one else is able to manage to produce mass production with the highest quality without going through the learning curve. There were trained over the years to be the best OEM suppliers around. For example, Foxconn, a multinational OEM company produces over 40% of electronic products worldwide, has more than one million employees in China, Brazil, Mexico, and Europe. It not only will remain growing in China, it will also continue to develop production capacity in other developing communities. It has learned to not only survive in a developing society, it rises by learning how to teach uneducated to work effectively, and places brought to a better living standard. Foxconn is worth giving a prize as a social development agent. Foxconn has made its brand too in OEM manufacturing clusters and taken the flying-geese lead in supply-chain migrations.

The traded-cluster map is trying to tell us a new story. The story will go beyond today's industrial infrastructure. The researcher is not surprised to tell you that Taiwan has only one dominated cluster, Information Technology (IT). Everything else is secondary. From the tabulation, the IT cluster occupies 10% of overall industrial and services employments. Including the supporting industries, over 50% of employments are clustered in one closely linked map[38]. There are some other industries such as petrochemical and textile industries, but each is less than 5% of the overall employments, and clusters such as biomedical industry is young and takes a long time and big investment to develop. The spillover effects for these young industries are limited. Even Taiwan's famous bicycle industry is a part of spillovers from the Production Machinery cluster. Although, the agriculture, Forestry, and Mining data are not included in this research, but the Food Processing and Distribution commercial clusters are included. They still account for a vital part of Taiwan's National Account balance.

This came not so surprising by looking at the cluster map that two largest bubbles rise up and the rests are small or local in Taiwan's cluster map (Figure 49), which accounts for 20% of all employments. Furthermore, the same correlation test was conducted on traded-cluster with a regrouping of all cities into North, Northwest, Middle, Southwest,

[38] The statistics clustering confirms this.

South, East, and Outer Islands districts. The result is the same as the city correlation, highly correlated into one dominated specialty.

This only proves that Taiwan has developed a single industry over the past 40 years with all its resources. Did Taiwan do well? Yes, it did. Is Taiwan in a danger? Yes, very. This fits the scenario of putting all eggs in one basket. Can Taiwan be more diversified? Yes, Taiwan is naturally being diversified driven by external shocks. There are good news and bad news. The bad news is some clusters will be facing continuous challenges such as shortage in labor, lack of funding to compete, lack of resources to upgrade, unfitted policies from the governments to support industries' needs, aging community, and the world worst birthrate adds salt to the wound. The good news is, there are natural spillovers waiting for Taiwan to rise again, with decisions, policies, retraining, business environment upgrades, upgrading infrastructure, new immigration and labor laws, environmental protection, and cluster initiatives waiting for the rebirth or rebuilt.

Now that we have a sense of direction, can we actually make it? The answer is how to do it with limited resources. The world is always with limited resources no matter where you are. People often note, the best resource in Taiwan is people. Taiwan has always been able to conquer the impossible despite who is ruling. English, Dutch, Japanese, and Chinese had all conquered Taiwan and ruled. Each time, the outside ruler came, they had left valuables such as business trades, logistics, communication, railroads and government infrastructure. Taiwan is infused with different cultures and tolerated with different lifestyles. People on this land learned to be tolerant, friendly, independent and adventurous. Facing uncertainty is part of their life, and entrepreneurship is in their blood. This adds an advantage for Taiwanese to take on the new challenges. A new economic era is here and is ready for more adaptations. Consider the time of 1970 when people carried suitcases flying all over the world to recruit businesses. Without the right language spoken, a calculator punching in their negotiated pricing was earning the trust to let them produce something to be shipped thousands miles away. Taiwan's people have earned the world trust becoming an OEM island. It is not the OEM business that is the most important. The value in the OEM manufacturing is the "TRUST" Taiwanese

provides. That is Taiwanese value, and that is the asset Taiwanese currently own. That is what Taiwanese should continue to sell in exchange for a prosperous life.

Taiwan does not have “Branding” because Taiwan has a “light” domestic market. There is an impression by the locals that most valuable domestically sold products are foreign made, and local products are considered cheap and with lower quality. Taiwan has recently gone through recycle cooking oil, and food chemical additives of food safety issues. Taiwan’s people are trying to strengthening law and reinforcement procedures. Between laws and pride, Taiwanese have not advanced to the pride level. Without reaching to the pride level, Taiwan will not have the real branded products. It is not what you make, it is an attitude that you are proud of what you are making. Many people are complaining that Taiwan does not have branded products.

One of famous brands Taiwan produces is the Giant bicycle. It is a spillover product of machine tool industry. A bicycle needs good tires, light frames, good shocks, and many other components to make a bicycle safe and comfortable. Besides, hundreds and thousands of little components are needed to make a competitive sports bicycle, and some bicycles may cost more than ten thousand US dollars. It not only has to run fast and be safe, it has to run long and be strong. A bicycle is the test for the whole machine tool industry, and the Middle district is famous for the Production Technology and Heavy Machinery. Taiwan has some amazing skills and designs waiting for new ways to be packaged and presented. Taiwan is like a treasure island. When you walk into the villages among the rice fields, some factories are making some pounding sounds, and that will be shipped perhaps to Niagara. Taiwan’s people fought so hard for the democracy, and they forgot there is something else that they have and worth fighting to keep - trust. Taiwanese needs to brand their trust to the world and to themselves. Porter says, a good sustaining industry is where they have domestically. Taiwanese has a local market for everyone to trade trust first.

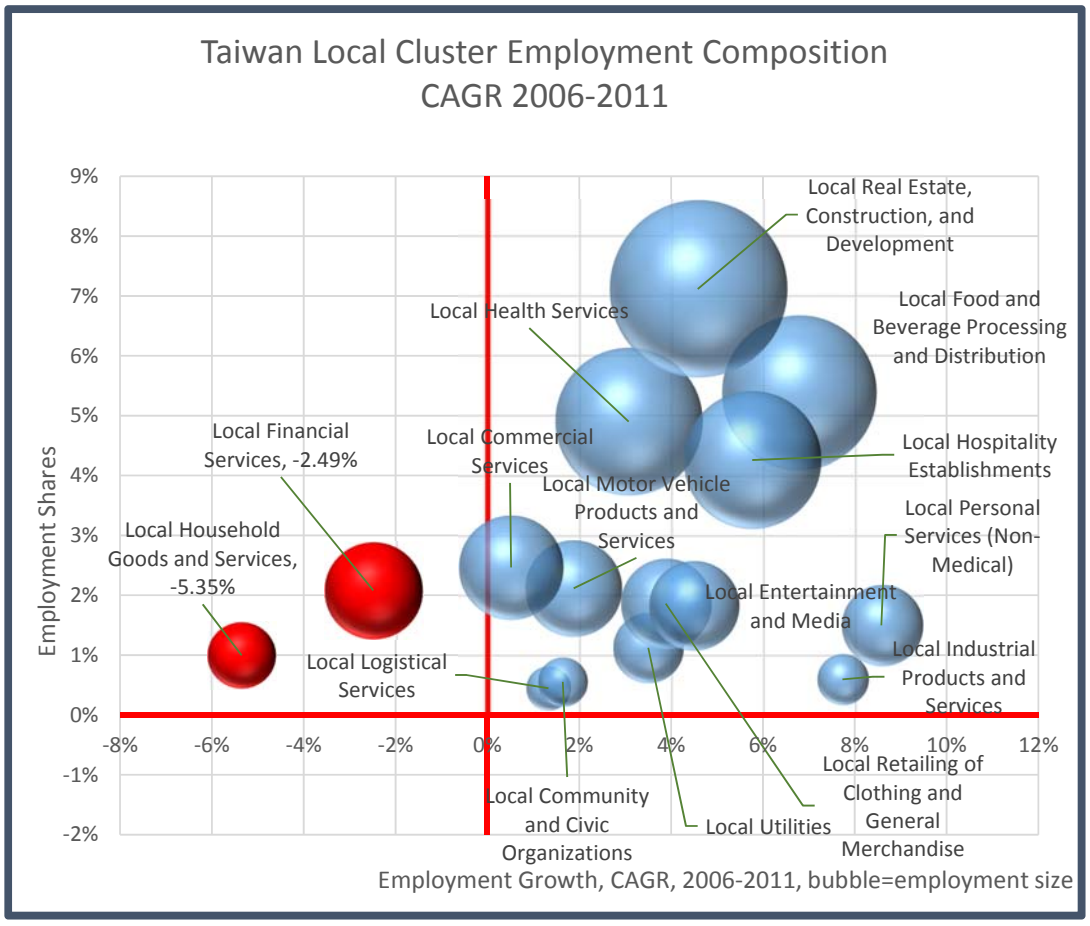
8.1.2. Local Clusters

This brings the second part of cluster map from the overall Taiwan clusters, which is the local clusters. There are 16 local clusters defined, and the two largest clusters are Local

Real Estate, Construction, and Development (7% of total employments); and Local Food and Beverage Processing and Distribution (5% of total employments). These two local cluster ranks the 3rd and 4th largest in all clusters. All other clusters in Taiwan traded or local are smaller than 5% shares. The census data does not include the general education local cluster data; therefore, the cluster is empty.

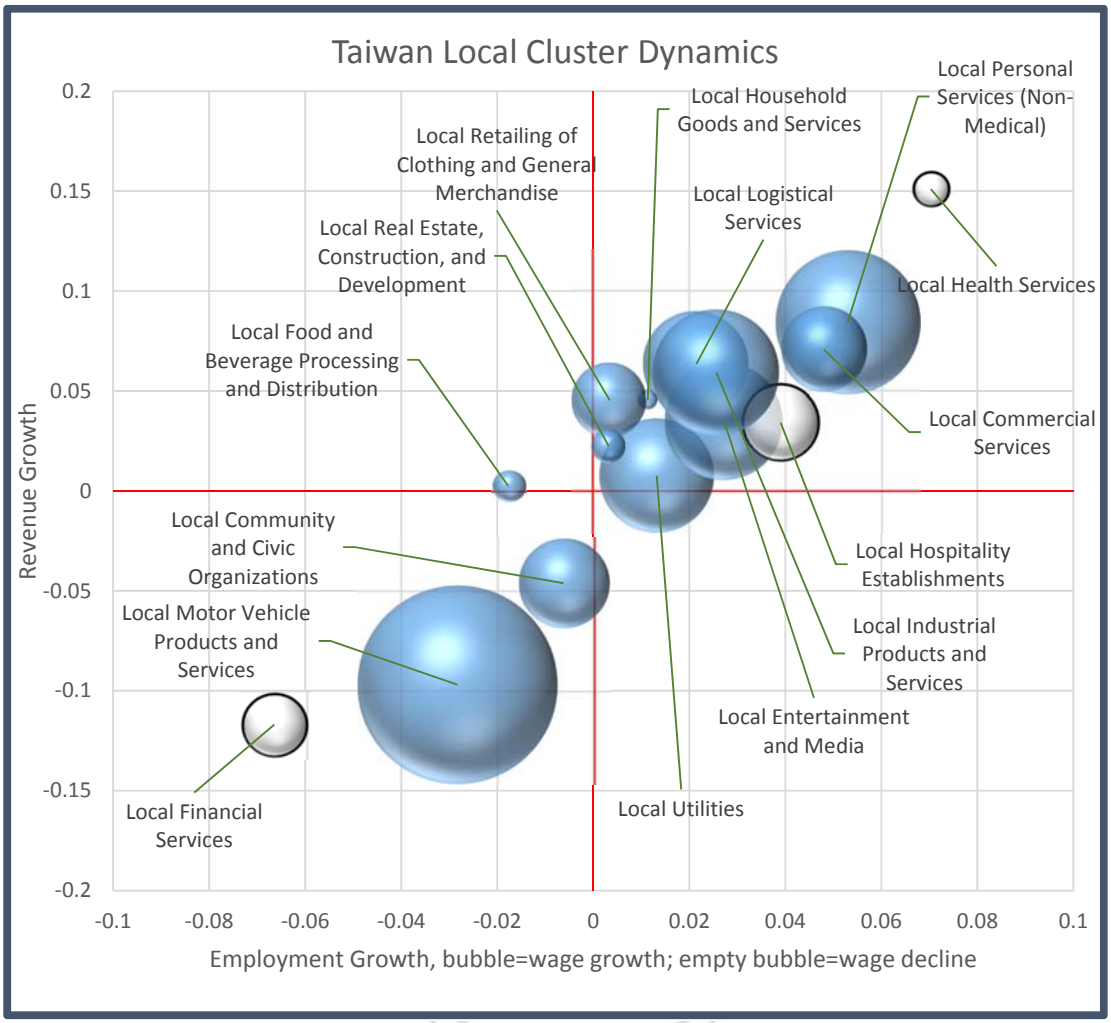
Below is the Local Cluster Employment Composition figure that includes employment growth, shares and size of all the Local clusters.

Figure 50 Taiwan's Local Cluster Employment Composition.



Source: Taiwan National Statistics Bureau

Figure 51 Taiwan Local Cluster Dynamics.



Source: Taiwan National Statistics Bureau

The fastest growing local cluster is the Local Personal Non-Medical Services, and the declining clusters are Local Financial Services (-2.49%), and Local Household Goods and Services (-5.35%). The same correlation conducted in the local clusters with the whole and separately as a group among all cities and Districts. The results show very little correlation between cities and Districts among all the cluster growth rates (See Appendix - Pearson's Correlation on Local Clusters' Growth Rates). They are pretty much growing independently of each other.

8.2. Clusters Compared to the US

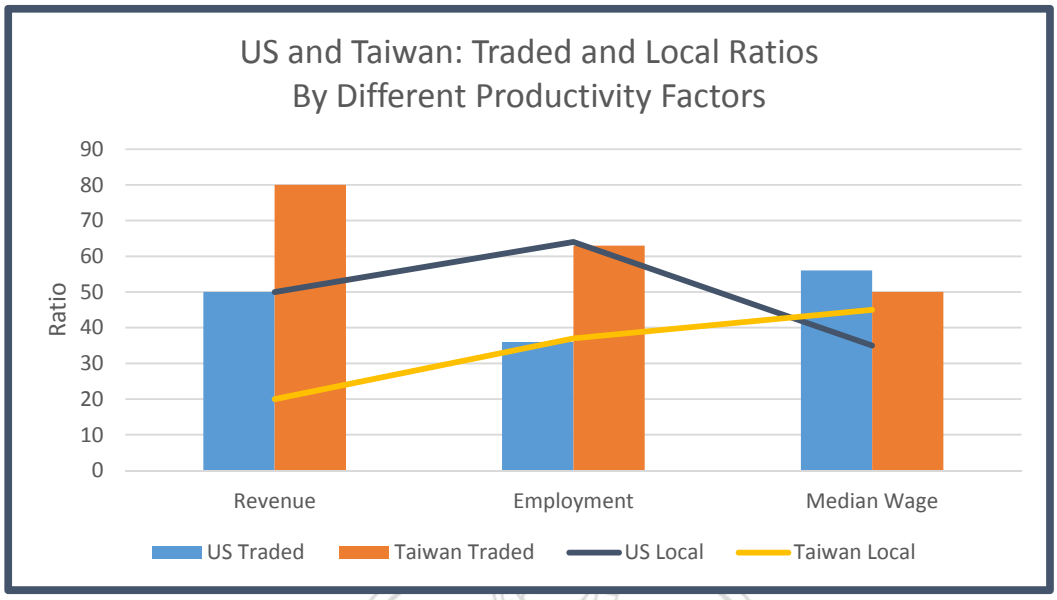
Since the US Cluster Code is used, a comparison between the US and Taiwan's ratios is done first. Taiwan's cluster employment ratios between the Traded and Local is 63:37 compared to the US ration of 40:60 which is just the reverse of Taiwan. Taiwan is traditionally a production economy, and it is migrating to production services. Now the growing clusters is indicating that Taiwan's Business Services cluster is growing in a fast rate (10%) across the board, and the cluster still in an early stage development, but the momentum is high. The US has the world healthiest open market, and it is Business Services cluster is the largest among all. The US market continues to grow in spite of financial crisis. The unemployment may have risen as high as 25% to some states for some very depressed areas such as Detroit, but the market demand was not affected during the 2008 financial crisis. The Traded and Local Clusters' income ratio between Taiwan and the US is 80:20 and 50:50 respectively. Both ratios indicate a completely different picture. Taiwan is an export oriented nation with a population of 23 million, 63% of Taiwan's industrial and trade working people (around 8 million) earn 80% of traded income, and 37% of people earn 20% of local income.

Figure 52 Taiwan and US Cluster Ratio Comparison.

Traded : Local Ratio	Taiwan	US
Revenue Ratio	80 : 20	50 : 50
Employment Ratio	63 : 37	40 : 60
Median Wage	NT$ 500,000:450,000	US$ 56,000:35,000

Figure 53 displayed two charts on revenue, employment and median wage ratio between Traded and Local clusters. One chart is derived from Taiwan's data, and another one is the US data for comparison. Taiwan's GINI coefficient is 33.8 in 2012 versus the US's GINI coefficient is around 40. Taiwan is slightly better than the US on income inequality ranking around 11, top the world. Below are Taiwan and the US charts on revenue, employment and wage ratios between Traded and Local clusters.

Figure 53 US and Taiwan Productivity Ratios in Traded and Local Clusters.



Source: *Taiwan National Statistics Bureau*, US Cluster Mapping

Taiwan's Traded and Local clusters are presenting a reversed ratio, especially the revenue and wage ratios. The Traded clusters make 4 times of revenue than the Local clusters, and median wages are very close. The businesses in the traded clusters are making twice as much as the local clusters. This demonstrates a much profitable business for the traded clusters than the local clusters for Taiwan. For the US clusters, more employment for the Local Clusters, but the median wage is about 50% higher in the traded clusters than the local clusters. This means more people are working in the Local Clusters and are with lower wages in the US.

While Taiwan has a small and isolated economy and the US have a large and open economy, the ratios show that Taiwan has a much smaller local market that three-quarters of workforce are participating in the traded market, and the wage differences are not big. There are 97.6% SMEs with two-thirds of the businesses export. Most of Taiwanese local businesses are small mom-and-pop shops, and many of them do not need to use formal

receipts since they are too small[39]. These businesses rarely grow into large businesses with few exceptions. For example, the night market shops open after 6 p.m. The frugal lifestyle does not have a big demand on the local markets. Goods selling in the night market are often cheap products from China or local discounts. The mentality is "low cost", one can see the cheap design compensating for cost saving.

8.3. Can Taiwan Brand?

Of course, Taiwan has some very high quality products as well, and they are mostly selling in the local specialty shops with. Those are mostly displayed in the shopping districts with high rent storefronts, and the price tag is only affordable by the wealthier people or for tourists. Of course Taiwan is not short of the riches, about 20% of the people are in the highest earning ranks departs from the rest of 80% earning ranks (see Figure 24) The storefront merchandizes are still considered to be inexpensive compare to the western brands. The cheap product mentality runs just the opposite of "Branding".

Cultural difference is another factor. One of electronic buyers who came to Taiwan to attend Taipei Computer Show and asked "Why are Taiwan's electronic products colorless?" I asked him why he asked the question. He replied "In Indonesia, color sells."[40] He has to make his products colorful in his shop in Indonesia and many selections for customers' buying appetite. "People will buy more with more color selections." according to him. "The local market is very active", and he is only focusing on the Jakarta market. Jakarta has a population of 10 million, and the local market is very vibrant.

By looking at the Local Cluster correlation, local ratios do not correlate well either in employment, revenue, nor wages. From the growth rates, there are four consistent specialties in the Local clusters: Local Food and Beverage Processing and Distribution; Local Health Services; Local Hospitality Establishments; Local Real Estate, Construction, and Development. From the definition, Local clusters serve the local

[39] Taiwan uses receipts system to keep track of bill of sales. A small business under the monthly income of US$60k does not need to use the Bill of Sales.
[40] Commented by Hsu, Longhua, a CEO of Power Supply Company, from Indonesia in October 30th 2013.

demands such as mom-and-pop shops or local hospitals. The French wine industry is both local and international. The Italian car business is local and international. The German, Japanese, and Korean car industry serves local and international.

Taiwan's local infrastructure is outdated including safety and law re-enforcement. Taiwanese has local car manufacture serves a small percentage of domestic market, and it has not developed international market. The bicycle industry has earned international reputation, but the locals rarely ride bike to work or school. Public transportation is very convenient in the big cities, students either walk or take public transportations to schools, and most people rides scooters to work because it is easier to park and inexpensive for the fuels. Business people drive if they have parking spaces, and large cities have parking issues. The road conditions are too dangerous for those who bikes. Furthermore, Taiwanese often claims to be a food heaven, but the recent food processing safety issues have prevented from people buying local cooking oils. People are willing to pay for expensive foreign made packaged food for the food safety standards. Additionally, Taiwan has a very good healthcare service that everyone is covered with inexpensive healthcare insurance. This local service has been a favorable local service and done well. These local industries without a supportive local market are difficult to sustain in the international markets and are branded internationally.

Of course, there are some exceptions, DingTaiFeng has made its branding internationally. Foreign visitors in Taiwan often commented how good Taiwan's fruits and vegetables are, and the varieties and its quality are out of the world. Taiwan has one famous food restaurant that is spreading in the world recently, and that is DingTaiFeng. It is making the class of its own and spreading like wildfires in many major cities in the world. The price is not low, but they always have long waiting lines. This is a local Taiwanese supply made to the world market branding. Evaluating some of the shops in different parts of the world, in Seattle, Los Angles, and Taipei, one thing people sees is they serve good food with consistency and clean restaurants with excellent services. The waiters and waitresses are well trained with good manners. They take a good care of the customers including waiters speaking different languages to serve the needed customers. They even protect your purse with a purse rack while eating the delicious food. The food

has the McDonald consistency but much higher quality, and the price is definitely higher than normal. The brand is demanded by customers domestically and internationally with excellent services. People eat there can trust that the consistency is always there. Often, people from Japan fly to Taipei for a meal of DengTaiFeng waiting in a long line. I asked one of Japanese girls who ate at Taipei DingTaiFeng, what does she like about the restaurant. She relied "The food tastes good, and it is very clean." The cleanliness has been commented several times when I surveyed people who went to DingTaiFeng. It is the management who wins the reputation, and the business is built on consistency. That is also what McDonalds builds on, the consistency. People often jokes about McDonald serves consistently unhealthy food, greasy hamburger and fried potatoes, but kids like them, so parents buy them; at least the food is safe. Branding is selling public trust. Taiwan needs to improve on public trust, and policies can help in this area.

Local market is important. There is much room to improve the local market by designing some good services and products to serve the local demands. When the demands are big enough, it will become collective exportable products and services, and Porter points out that one location must have a healthy local demand to support the traded products. This is one of Taiwan's OEM's weaknesses. It only gets the order when someone else has surveyed the market and learned the demands. After the design is made, it is sent for OEM production. The OEM companies might not ever know why it is designed in a certain way. OEM is only responsible for making it work the way customers want it, but the buyers are not the users. OEM does not need to support the storefronts. It will support the exchange or returns by the buyers' demand that is a distribution company.

OEMs receive the second-hand information from the distributors, and their job is to be sure buyers' demand is perfectly set with the cost negotiated. OEM is not at the market front; they do not have market knowledge; they have production knowledge. OEM is designing the production process, not the products, for mass markets. OEM rarely surveys the market front but the design trail version is always targeted for a mass market. Without that pre-condition of a mass production, OEM cannot be profitable. Most OEM production costs are surprisingly low. This puts Taiwan's majority workforce in a non-market front. This is not because Taiwan can only do OEM businesses. Taiwan has very

limited specialties market besides being a blue-collar worker for 40 years now. Taiwan needs to break out of the nutshell and develop their own specialization instead competing on cost. How can Taiwan improve that?

8.4. Learning from Successful Cluster Initiatives

One successful case that is worth learning is the Netherlands' FloraHolland's success in turning a severely competing flower growers' case into a global business opportunity[41]. The Dutch was facing the similar problem with a severe pricing competition on flower growing and marketing issues. It was facing Asian's low-price labor rise, and unpredictable market competition, mostly on very low pricing. On one hand, the Netherlands has the most stringent labor laws. It is impossible for Dutch to compete with low labor cost, and yet the business needs a good sustainable solution for the jobs and for the wellbeing of Dutch citizens. Flowers have always been European favorite products on daily markets. It is a tradition for European to use flowers for many occasions, so there are local demands for flowers. Instead of being trapped into deeper cut-throat competitions, the Dutch initiated a Dutch Flower cluster initiative and decided to advance its logistics, storage, auction and quality control system into a turnkey solution and share their new solution with the rest of the world, so that competition becomes a shared-market and expandable value. It helps flower growers in every corner of the world to quickly sell the best flowers they can grow with the highest profits they deserve. Everyone benefits from this cohesive designed solution. The Dutch turned from disasters into a fair market value system.

https://www.youtube.com/watch?v=Slf_XNroXS8 describe the value of the system well.

This successful cluster initiative is worth Taiwan's attention. What can Taiwan learn from the Dutch? Flowers have always been most European's favorite households' goods. It warms people's hearts and sooth their emotions. Holland has slightly bigger land size (41,543km²) of Taiwan (36,193km²) with a little less population (17 million for Holland, 23 million for Taiwan), but Taiwan has one and half times of population density due to the high mountain ridge in the central part of Taiwan. Similarly, both Holland and

[41] https://www.floraholland.com/en/ ; https://www.youtube.com/watch?v=Slf_XNroXS8

Taiwan rely on the sea. Taiwan was once Holland's colony in the early 17th century. Both Holland and Taiwan have strong economic and political neighbors, Germany and China respectively. It is inevitable for both countries to feel the giants' pressures. Holland needs to reach out to the world for its economic prosperity since resources are limited. This is very similar to Taiwan. Holland at its desperation to compete its floral business and came up with a turnkey solution to build its national competitiveness. The strategy can benefit floral growers in the world, and the system has been well accepted by even the cheapest flower growers in other corners of the world. Even China bought into their turnkey solution.

Flower is Dutch's culture just like French wines. Because their living passion for flowers, it becomes an important part of their businesses as well. This becomes a general local market demand since passion is not something easily abandoned, but a healthy local market also needs to demonstrate its massiveness in order to make it a national specialty and trade internationally. Only when it reaches a certain population can support the market varieties either goods or services. Dutch perfected the flower trading system from flower growers. It has a quick, accurate, and fair evaluation and bidding process that flower growers are incentivized by superior quality if they use the system. The system guarantees the highest bidder gets the best quality flowers. The system is also designed with timeliness bidding system that can trade globally. The nature of cut-flower in general has 7 days to live which means the faster the flowers are in customers' hands, the higher quality of delivering fresh flowers into buyer's hands. What FloraHolland has provided is a solution to a very difficult and challenging issue, and the answer is to utilize the most updated technologies to fit the process into solving intensive real-time dynamic problems, which is timely delivery of the freshest flowers to the hands of flower lovers with the fairest price, and at the end the flower growers know how to grow better flowers in order to get the highest return.

The turnkey system is done with the cohesively designed flow and equipment to accommodate everyone's demand and communication. An open and sharing system has brought the competition to another level. It is no longer the hatred relationship among flower growers and middle trading men who may buy low and sell high. It is a productive

system for people to measure high and return high. It is a win-win system that all points of providers and receivers gets the best satisfaction out of the beauty of flowers. In order to reach to this point, it takes a group of people to start an initiative and focusing stakeholders' effort in a cohesive collectively into a full collaboration. They have designed outcome first, set goals, draws solutions, and implemented the system. The final outcome was very satisfactory. It is the biggest flower trading system in the world, and they solve the problem of industry agglomeration by using the latest technology by inventing a perfect trading and delivery system. This sets an excellent example of cluster initiative.

Globalization and technologies provide open information and communication channels. The Dutch flower's case demonstrates how to utilize the most advance technologies to solve market competition issues. A well-designed system can provide many solutions for many ends individually and as a whole, and the collaborative work in a seamless process can make everyone happy and profitable. In this case, flower growers from China may benefit from growing flowers in a marketable expectation and receives return on a fair and open-bid system. He may play a small roll, but he is receiving a calculated fair return. A FloraHolland researcher spoke about a Chinese wholesaler trying to imitate the system and failed.[42] The system is too complex to be copied. At the end, Chinese contracted FloraHolland to build a trading system in Kunming's flower market fair for all growers to benefit. Flower growers pay about 1% of the trading fee that is much lower and secured than the tradition bidding method. Additionally, for FloraHolland, the bestselling product is a weather-proved greenhouse to Chinese growers to ensure the quality of their flowers for the highest return. For Chinese it is too difficult and too expensive to build a complex logistic, storage, and bidding system with knowledgeable quality control personnel that is close to the market. Here the Dutch built the value into a system to serve people utilizing the latest technologies to build a state-of-arts turkey system. It successfully served the stable and highly demanding European flower market.

[42] The story was told in the Harvard Business School Microeconomic of Competitiveness course. A staff was invited to speak about their business success in the class.

By the same token, Taiwan has many possibilities to expand their local specializations, especially Taiwan is a technology rich economy.

This is one case demonstrating cluster initiative works from a bottom-up project with success. In Europe, there are more than thousands of the clusters initiatives that has been proposed and are working effectively. The US has just started in 2014 after the cluster tools are built for people to survey the resources to propose for workable local initiatives. The concept of cluster initiatives has only been used by few Asian countries such as Singapore, Korea, and Japan. Other Asian countries are still new to the concept. cluster mapping is tool designed and built for cluster initiatives proposed by practitioners, researchers, and policy makers. Taiwan is starting its first cluster mapping tool here.

8.5. Can Hsinchu Become Another Silicon Valley?

Since Hsinchu is Taiwan's most successful and dominated cluster, one may ask the question: "Can Hsinchu become Silicon Valley to make the first hand innovation? My answer is "No". Silicon Valley and Hsinchu are structured differently that Silicon Valley is a design center, and Hsinchu is a production center. Their workforce has different training background and working mentality. Silicon Valley designers make innovative designs based on mass-market input for Taiwan to manufacture. It is a consumer design and the testing is by people versus the testing for Taiwan's design is by machines. Hsinchu designers are production service base, and it depends on a small set of customers to make very large production output. Taiwan has a greater consistent regularity because it needs to make the McDonald type of consistency. Furthermore, Silicon Valley designs products for people to test, the design process is very different from the machine test. It needs to understand market demands and users' needs, and make decisions to justify the market shares. At the end, if the analysis is successful, the reward is very big for Silicon Valley innovators since they are close to the market, but their failure rate is very big as well because the market acceptance may take time.

Taiwan has less risk but smaller profit margin since the market acceptance risk is taken by their customers. The after sales effort is very different from the production model too. Taiwan will have very little after sales effort versus Silicon Valley will have to deal with

consumer complaints and refund. The US for years has improved its business service support that the consumer laws regulates merchants with a very tight law to sell their products. Taiwan, unless it improves the consumer law and changes its design mentality, is not another Silicon Valley. Basically, Silicon Valley has developed the knowledge and skills to deal with consumer markets, and Taiwanese has developed the knowledge and skills for production services. The two are different models. When the model is changed for Taiwan, Taiwan will need to change their mentality to build a consumer-based and service-oriented business environment. It can be done, but it will take an economic development structural change. The strategy for the consumer market development initiative will be very different from the IT production services Clusters. Taiwan's Business Service Cluster is on the growth; this is an area that Taiwan can put efforts in converting the production working mentality into the market oriented mentality. Paying for services is still a weakness in Taiwan.

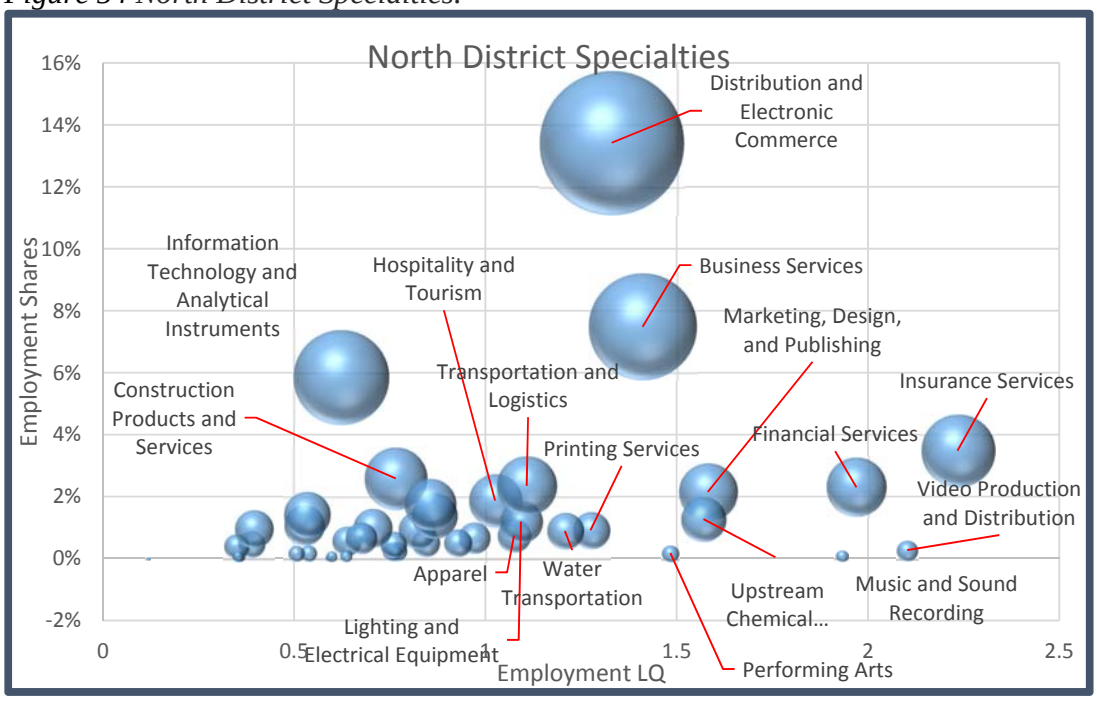
9. Regional Analyses

The district level is defined as the regional unit in this Chapter. There are total of 7 districts. Each region will be presented with the specialty strength in LQ, employment shares, and sizes on traded clusters. LQ greater than one meaning the regional shares of a cluster carries more weight than the national shares, and thus is more specialized. Some very highly specialized clusters are in very small regions with limited clusters such as the Outer Islands District. The highly specialized clusters most often are locally developed by the local endowments or geographical resources to form the natural lifestyle. Some of these highly concentrated clusters may have potentials to become the next star cluster provided cluster initiative is well planned for growths. For the analysis of the district regions by using 2011 population data, each region has employment growth and specialization calculated to form two maps. One is the Specialty map to show the specializations of cluster formation, and the other map is the Specialty and Growths map to show the dynamics of specialized clusters.

9.1. North District –Pei-Pei-Kee

Distribution and Electronic Commerce specialty is the top focus in this region. The North region has a population of 6,947,346. Central Government offices and most businesses and banks headquartered in Taipei City. Tourists and international travelers check in Taipei since higher-end hotels are mostly located in Taipei. Keelung has an ocean port and many freight docks. Water activities are important for Keelung. This is the closest port to Japan, and was earlier built to serve trades to Japan. Japan is an important trade partner of Taiwan. New Taipei City has the largest population of Taiwan, and Taipei City has the highest population density.

Figure 54 North District Specialties.

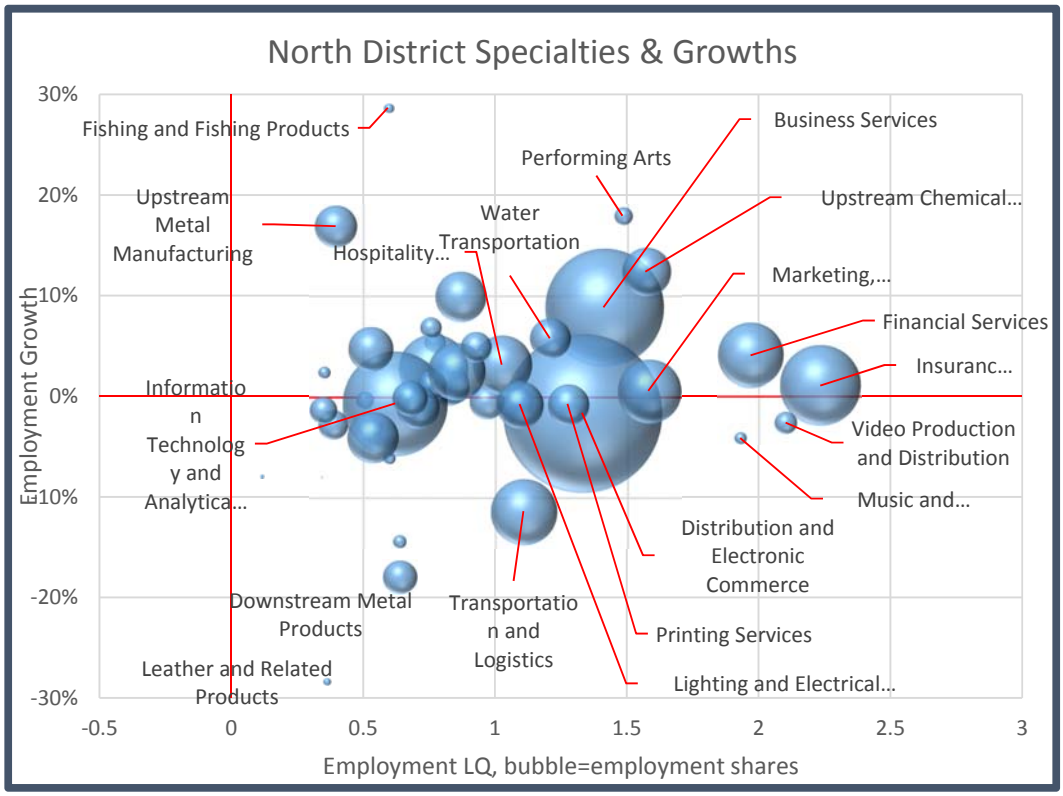


Source: *Taiwan National Statistics Bureau*

The largest cluster is the Distribution and Electronic Commerce with 13.4% shares of the region total, followed by the Business Service with 7.5% shares of the region total. The highest two concentrated (LQ>=2) clusters are Insurance Services cluster with 3.5% shares and the Video Production and Distribution cluster with 2.7% shares. The Business Services cluster with 2.3% shares almost made to the high national concentration group.

The Information Technology and Analytical Instruments cluster although has a 5.8% shares does not have enough concentration to be in the national specialty category for this region. The next group of clusters worth observing is the Marketing, Design, and Publishing, Transportation and Logistics, and Hospitality and Tourism clusters. This group around 2% shares clusters play an important role supporting the international trades. Below are the growth factors from the employment CAGR.

Figure 55 North District Specialties and Growths.



Source: *Taiwan National Statistics Bureau*

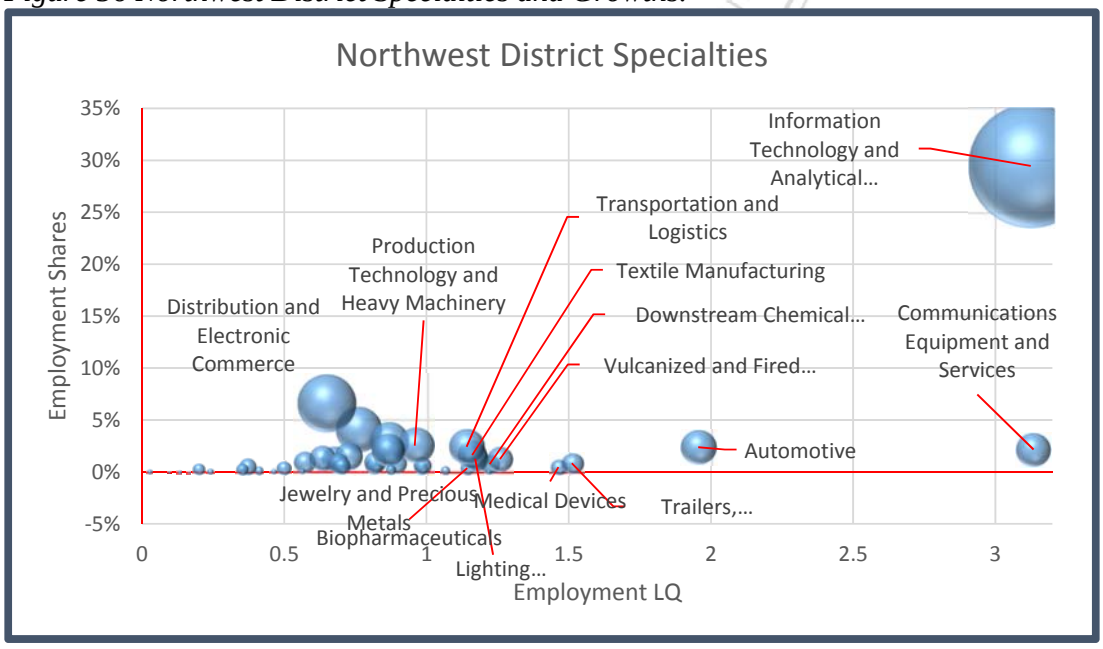
The highest growth cluster within national concentration is a smaller cluster, Performing Arts, with a growth rate close to 20%. The Upstream Chemical Products cluster is growing over 10% rates, and the Business Services cluster is growing close to 10% rates. The largest specialty cluster, Distribution and Electronic Commerce, is at a decline. Transportation and Logistics cluster is declining over 10% rates which is a sharp drop. These two clusters are worth North Regional cities to examine and take some initiatives.

9.2. Northwest District Region – Tao-Chu-Miao

The Information Technology and Analytical Instrument (IT) Cluster is the highest focus in this region. Norwest region has a population of 3,513,008 and has a high-tech (Hsinchu) industrial park hosting many high-tech companies. TSMC and China Motor Corporation (a Taiwanese car manufacture) headquarter in the region. Industrial Technology Research Institute (ITRI) established in 1973 with over 6,000 researchers is an important non-profit research institute brought Taiwan from a labor-intensive industry into a high-tech intensive production industry. ITRI continues to invent new technologies and production processes to enhance high-tech industrial needs.

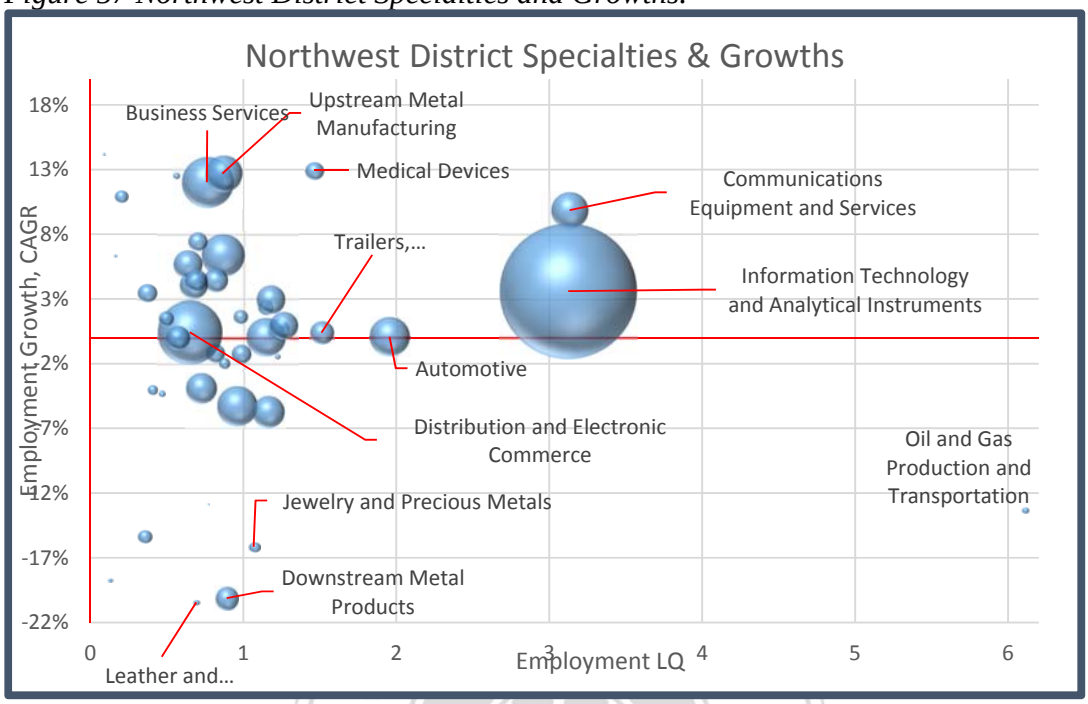
Information Technology and Analytical Instrument (IT) dominates this region with over 25% shares of employment in the area. Another highly concentrated cluster is Communications Equipment and Services, and Automotive. The cluster is not so big, below 5% employments shares, but it serves the IT cluster as a complementary and supporting cluster. Distribution and Electronic Commerce, although has over 5% shares, but its concentration is not high enough to make the national importance. The North region has the specialization for this cluster.

Figure 56 Northwest District Specialties and Growths.



Source: *Taiwan National Statistics Bureau*

Figure 57 Northwest District Specialties and Growths.



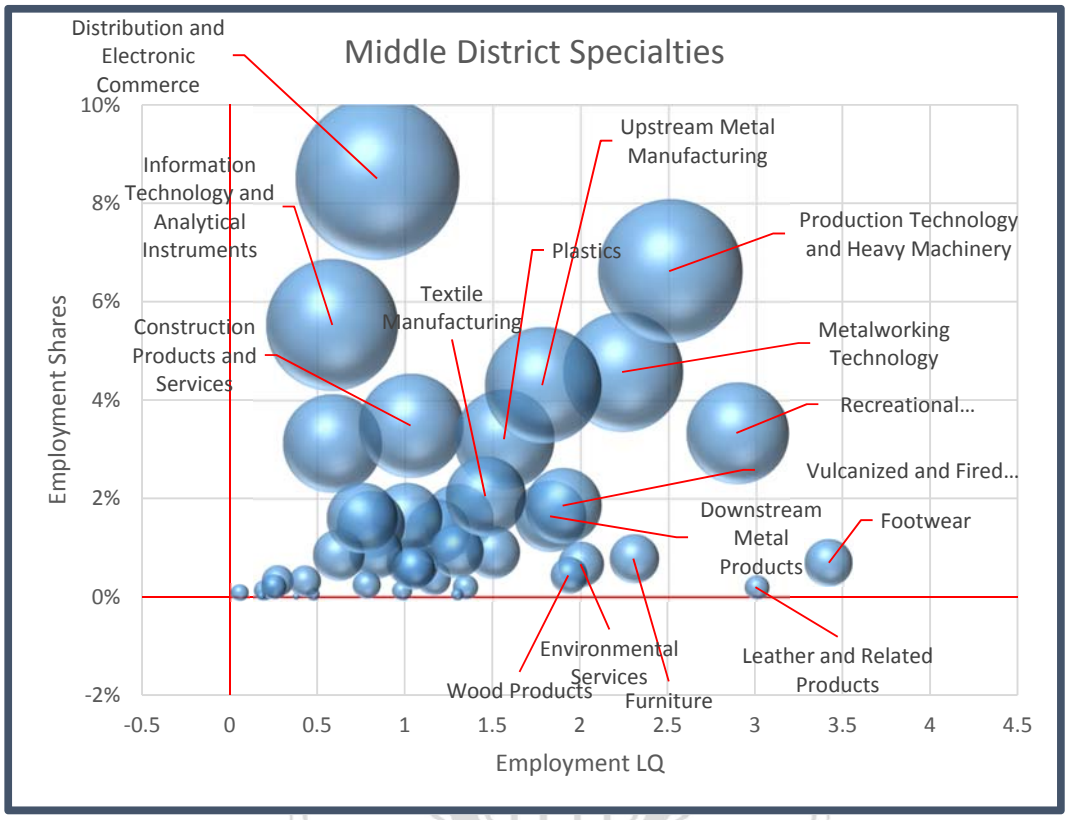
Source: *Taiwan National Statistics Bureau*

The Medical devices, a national specialty, although a small cluster is rising at a 13% rates, followed by Communications Equipment and Services over 8% growth rates, and IT is rising at a slower rate a little over 3%. The declining cluster with over 20% drop rate is Downstream Metal Products, although not in the national concentration but still alarming. Jewelry is a small cluster but nationally important is facing a steep decline at over 15% rates. Most noticeable is the Oils and Gas Production and Transportation cluster with a very high concentration in the area is dropping over 12% rates. This is a highly specialized and a small cluster, but dropping rate is worth some further analyses.

9.3. Middle District Region – Chung-Chang-Tou

With a population of 4,490,240, also the second largest population, Production Technology and Heavy Machinery is the central specialty of this region.

Figure 58 Middle District Specialties.

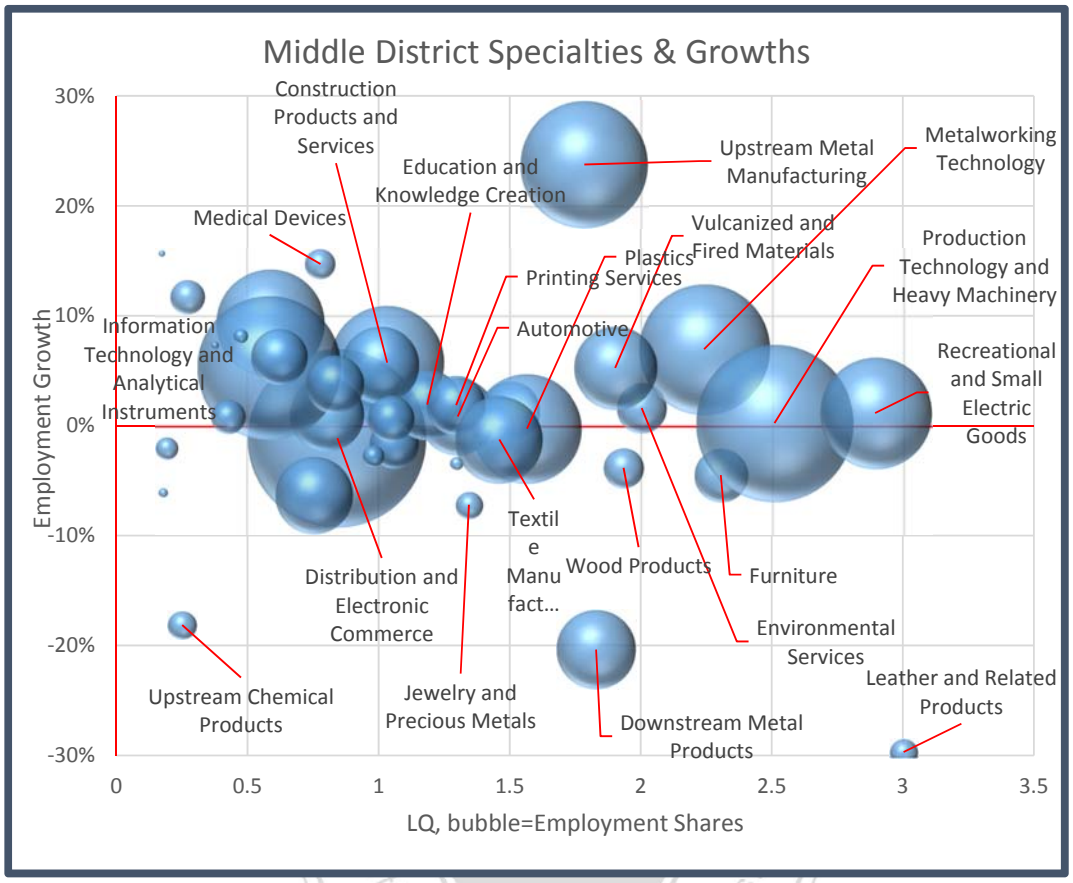


Source: *Taiwan National Statistics Bureau*

This region has a very different landscape from the north. This is a region evenly spread out with middle size and strong clusters (around 5% labor participation) and highly networked clusters. The Production Technology and Heavy Machinery leads Metalworking Technology, Textile Manufacturing, Upstream Metal Manufacturing, Downstream Metal Products, Plastics clusters in larger clustering activities. Their growth rates are paced together because these clusters share the same industrial value-chain. The division of work is very strong here. This region also supports other regions for their productions and orders such as the Northeast region activities. Distribution and Electronic Commerce although is the biggest but not a national concentration. What this means is that the clustered value-chain overpowers the Distribution and Ecommerce cluster.

Next analysis is the employment growth on specialties of the Middle region.

Figure 59 Middle District Specialties and Growths.



Source: *Taiwan National Statistics Bureau*

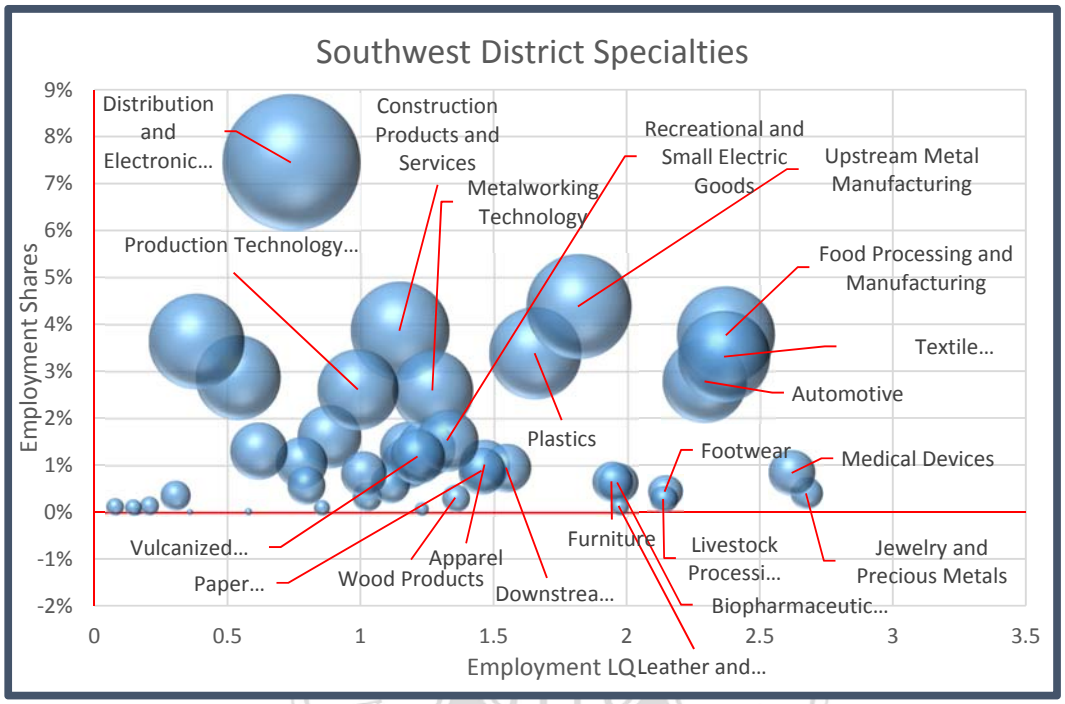
The highest growth of higher concentration cluster is Upstream Metal Manufacturing following by Metalworking Technology clusters. The specialized machinery group is all growing with the exception of Downstream Metal Products, and this is worth looking into the cause of the separation of the clusters group. The largest cluster in the region, the Distribution and Electronic Commerce is declining and is worth a study. The Medical Device cluster is growing over 10% rates, although small but worth to see if an initiative is valuable to help the emerging cluster. IT is a large cluster about 5% shares but not a major concentration in this region.

9.4. Southwest District – Yun-Chia-Nan

The Southwest (population of 3,399,984) was very famous for textile manufacturing before the mass migration to China after Chinese opens up their international trades in the

late 1980s. This area has its historical backdrop of Dutch occupation and earlier Han history with Taiwan ocean port nearby brought trades internationally.

Figure 60 Southwest District Specialties.

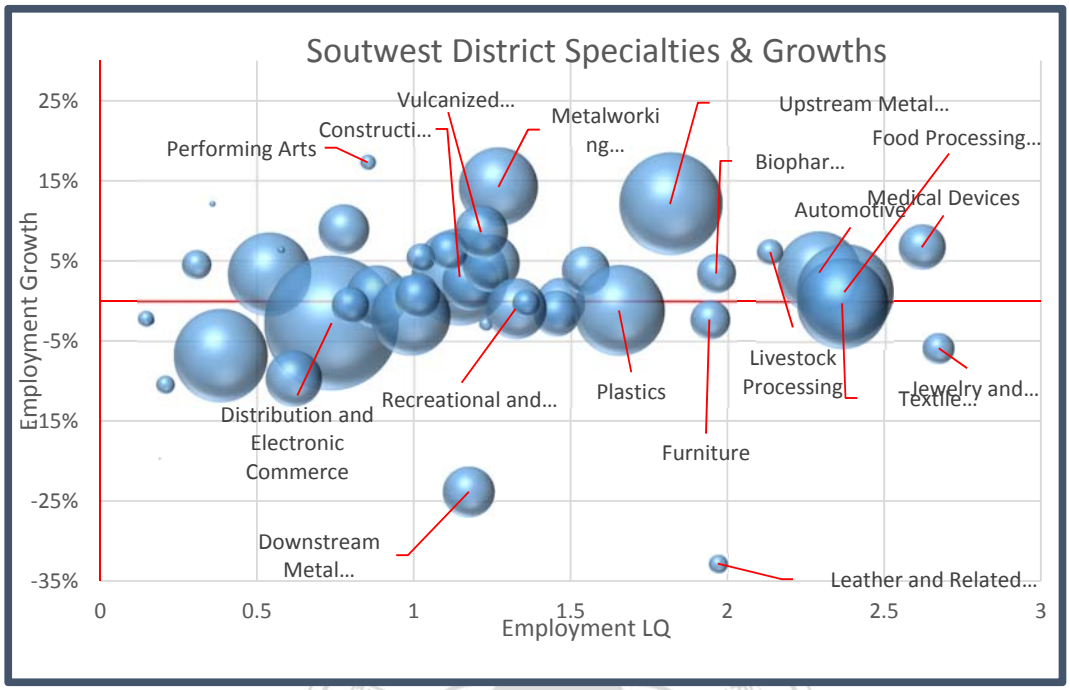


Source: *Taiwan National Statistics Bureau*

Most of the clusters are below 5% shares regionally with one exception of the Distribution and Electronic Commerce, but the cluster is not a national concentration. There are varieties of cluster groups such as the very highly concentrated group has more contemporary clusters with Medical Devices, Biopharmaceuticals, and Jewelry and Precious Metals. A second cluster group is a more traditional manufacturing group with Food Processing and Manufacturing, Textile Manufacturing and Automotive. Then we have local specialization group of Footwear, Livestock Processing, Furniture. The most clustered are in the production manufacturing group of Upstream Metal Manufacturing, Plastics, Metalworking Technology, Construction Production and Services, Recreational and Small Electronic Goods, Downstream Metal Products, Apparel, and Wood Products.

Next analysis is the employment growth on specialties of the Southwest region.

Figure 61 Southwest District Specialties and Growths.



Source: *Taiwan National Statistics Bureau*

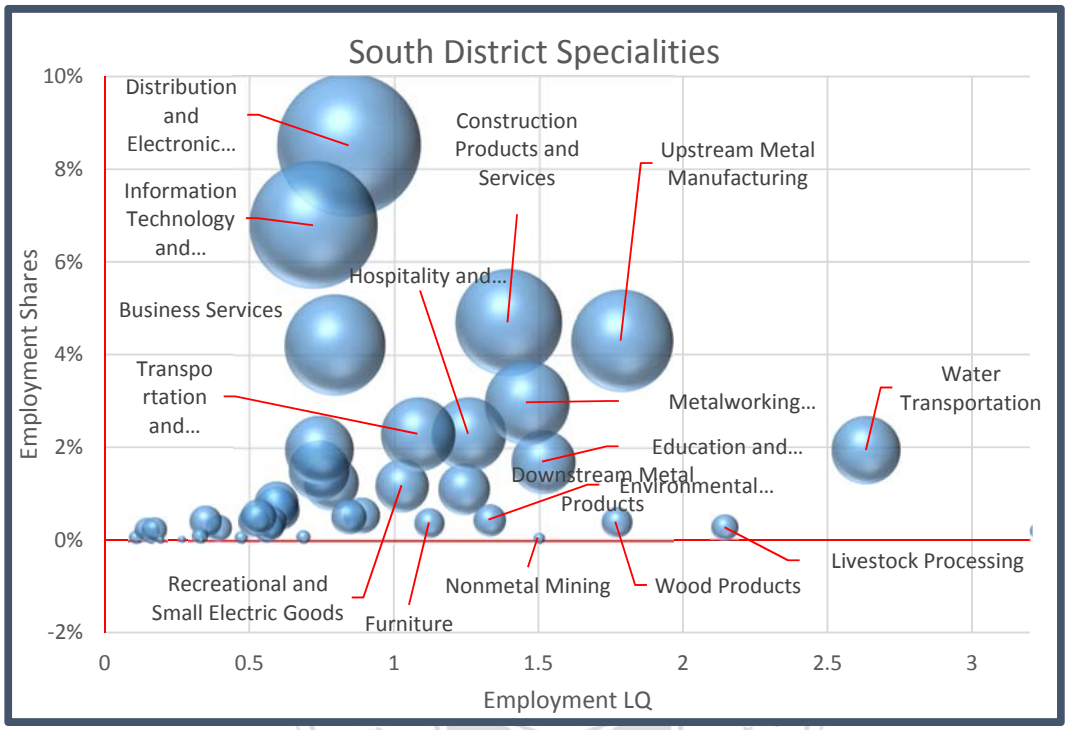
The two highest growth clusters are Metalworking Technology, and Upstream Metal Manufacturing. Performing Arts although not a national concentration but is rising over 15% growths. This may be due to the latest promotion of cultural program policy to boost the national cultural industry. Other specialized groups are growing in a slower pace below 5% rates. Distribution and Electronic Commerce, the largest cluster not in national concentration, is declining. The worst decline is Downstream Metal Products with close to 25% declining rates. The Leather and Related Products are somewhat distorted cluster because the cluster has been split into two with Footwear added.

9.5. South District – Kao-Ping

The South region (population of 3,638,999) is the third largest population of Taiwan. It is famous for its hotter weather and agricultural lifestyle. Kaohsiung Port used to have the world number one ranking and now has been taking over by Shanghai, China. This area has large Oil refinery, shipbuilding factory, and steel processing company. It is

considered a heavy industrial area. The south tip of Taiwan has beautiful ocean and attracts many tourists to the area.

Figure 62 South District Specialties and Growths.

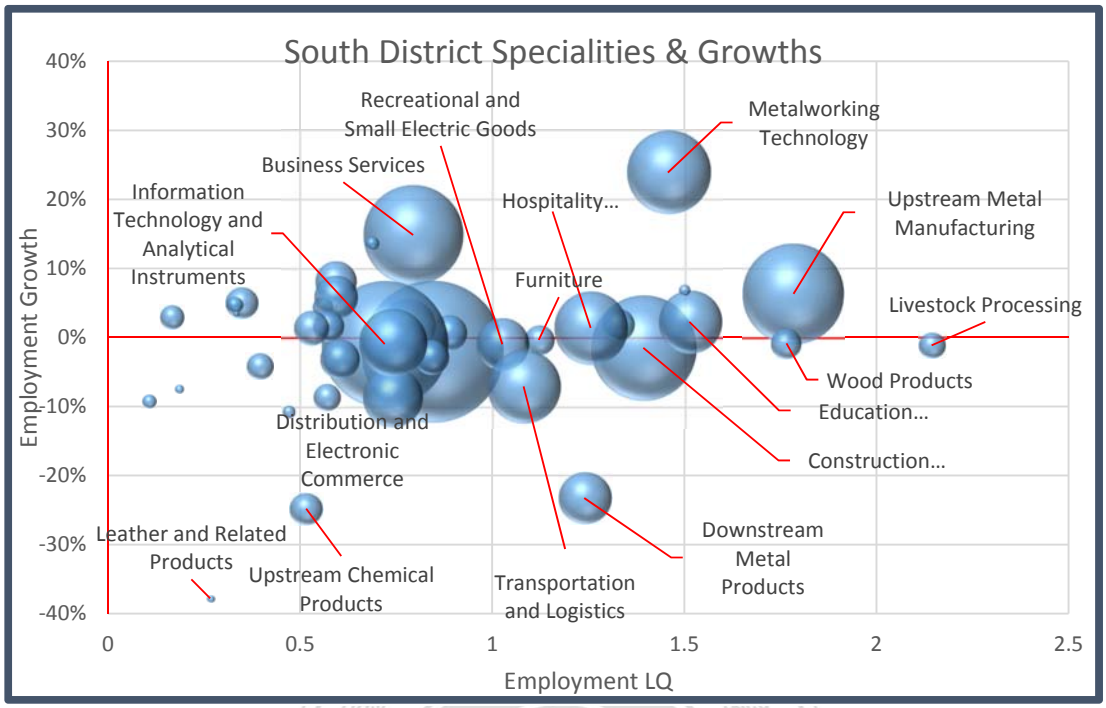


Source: *Taiwan National Statistics Bureau*

The highest cluster is obviously the Water Transportation cluster, followed by Livestock Processing. Upstream Metal Manufacturing, Downstream Metal products, Metalworking Technology, Construction Products and Services clusters of production group has a major weight to the national concentration. Hospitality and Tourism and Transportation and Logistics, Recreation and Small Electric Goods are of national concentrations in this region.

Next analysis is the employment growth on specialties of the South region.

Figure 63 South District Specialties and Growths.



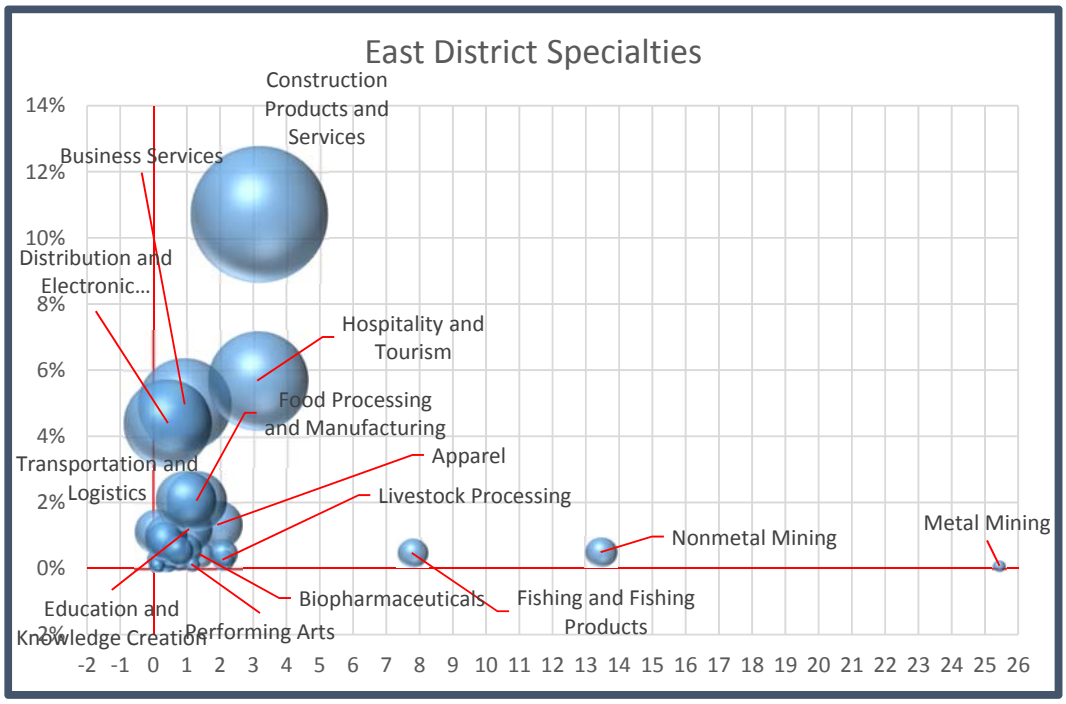
Source: *Taiwan National Statistics Bureau*

The production group of Metalworking Technology and Upstream Metal Manufacturing is having a high growth that are nationally specialized clusters in this region. Unfortunately, we are seeing consistent decline on Downstream Metal Products with over 20% down rates. The Upstream Chemical Product is another severely declining cluster with over 20% declining rates. Transportation is another important cluster here facing over 5% declining rates, and this is an important cluster in this region worth looking into it. The largest employment group is Distribution and Electronic Commerce that is declining, although not in the national concentration but the shares matters. IT is the second largest cluster has a small declining rate but also big enough to matter. Business Service is on the rise, and its share is large enough to take some future potential. Taiwan is still small on Business Services, and this is a growing cluster throughout Taiwan.

9.6. East District - Yilan, Hualien, Taitung

The East region (population of 1,024,189) faces the Pacific Ocean and is at the foothill of central ridge mountain. Part of shoreline has some very steep drops. The landscape is very pretty; many aboriginal tribes reside around the shoreline area. The tribes have traditional handcraft and cultural rituals which are important parts of growing Performing Arts and Tourism industries.

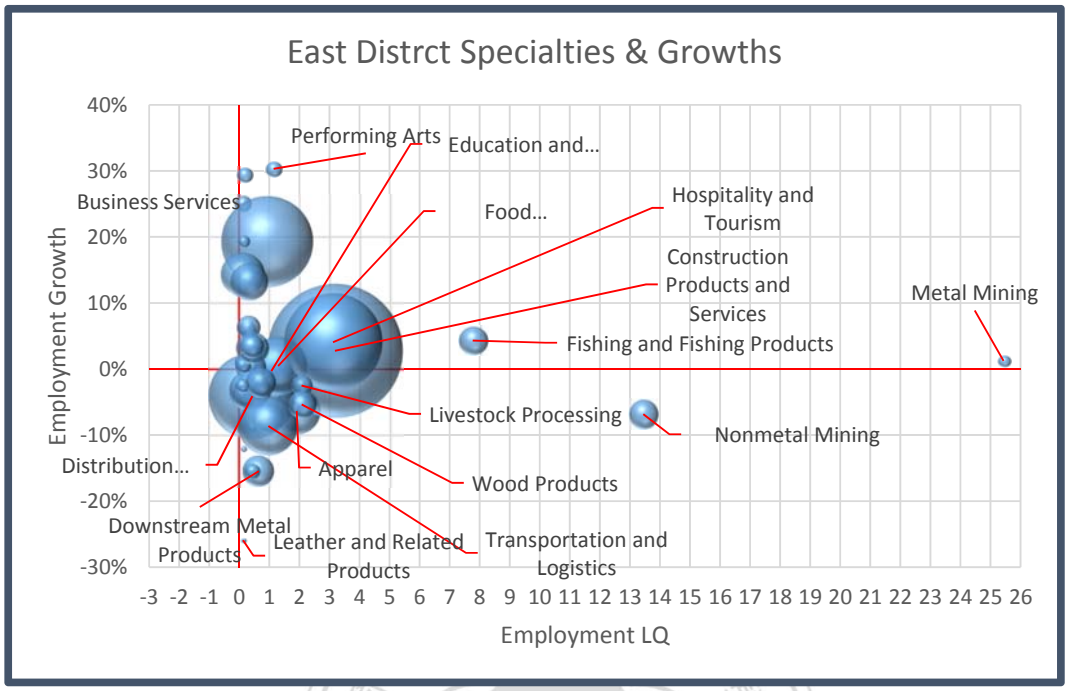
Figure 64 East District Specialties.



Source: *Taiwan National Statistics Bureau*

For its scenic backdrop and local specialization, it is not difficult to see the Hospitality and Tourism, and Construction Products and Services being the highly concentrated national specialties. This is a region with Taiwanese Jade and marbles. The mining business of Metal Mining and Nonmetal Mining are the highest clusters. This is the region with some precious endowments that can be mined. Fishing and Finishing Products, and Food Processing clusters are obviously important for the next Pacific catches for processing seafood. These clusters are part of local lifestyle for centuries.

Figure 65 East District Specialties and Growths.



Source: *Taiwan National Statistics Bureau*

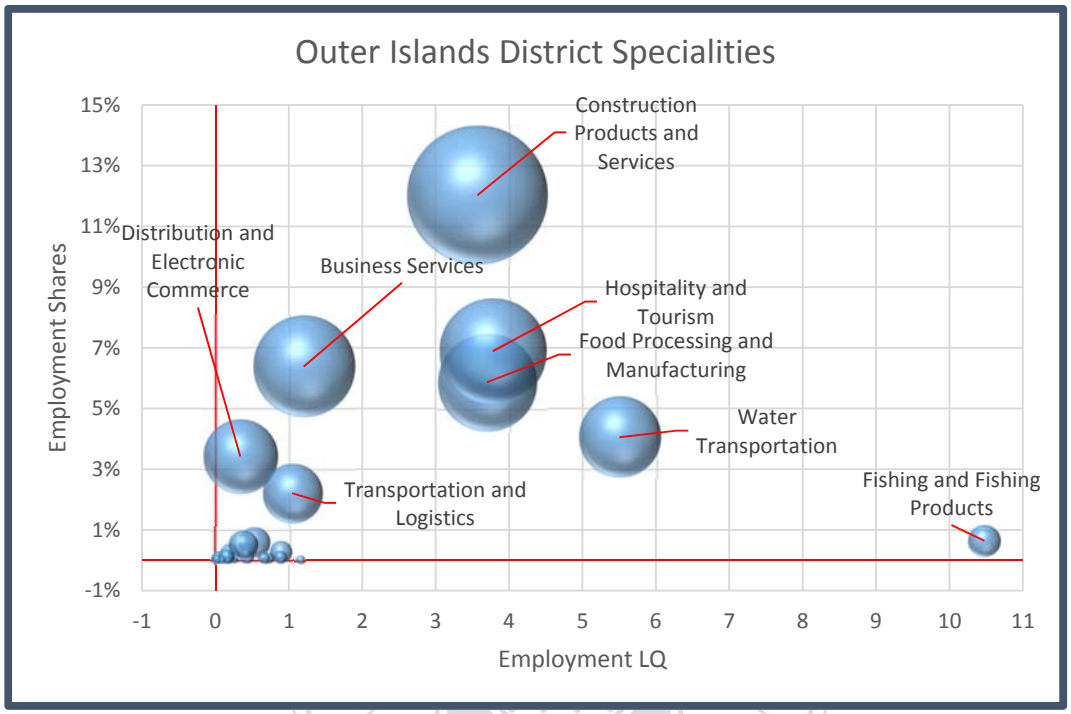
The highest rise is the Performing Arts cluster. This may be due to the latest effect by Taiwan and China Economic Cooperation Economic Framework agreement that brought many Chinese tourists in the region. The place has become a major tourist attraction since 2009. The related clusters benefited from that is the Hospitality and Tourism and Construction and Products and Services. The Nonmetal Mining highly specialized cluster is at a decline over 5% rates. Transportation and Logistics cluster is facing over 5% down turns. Distribution and Electronic Commerce is at a decline although not in the national concentration. Although Business Services cluster is not in the national concentration, but is on a fast rise of close to 20% growing rates. This is a consistent growing cluster in Taiwan.

9.7. Outer Island District – Penghu, Kinmen, Lienchiang

The Outer Island region (population of 211,146) is small but important for Taiwan's national security. Some islands are very close to China, and they are all occupied with

military service troops. The region primarily serves the military staff, and lately due to ECFA agreement, many Chinese tourists are active in these islands.

Figure 66 Outer Island District Specialties.

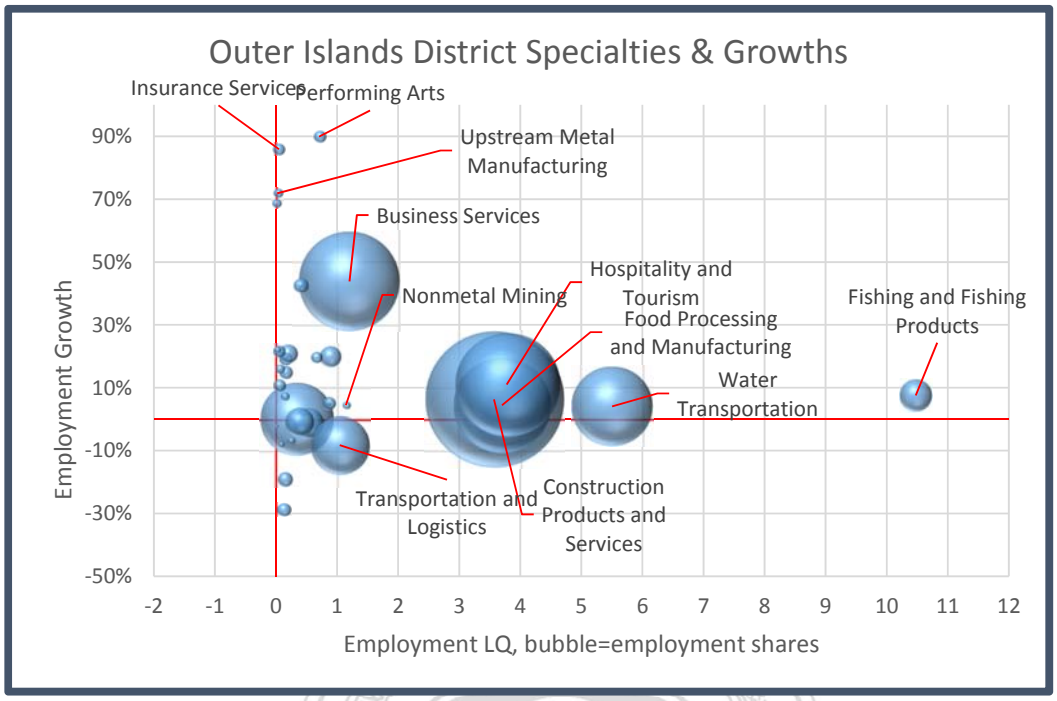


Source: *Taiwan National Statistics Bureau*

The Fishing and Fishing Products cluster is the highly specialized cluster. The biggest cluster is Construction Products and Services which has an over 12% shares. Hospitality and Tourism, Food Processing and Manufacturing, and Water Transportation clusters are highly specialized cluster which holds around 5% shares. Business Services cluster is over 5% shares and is specialized in this region. Transportation has less than 3% shares also a specialized cluster. Not all clusters are presented in this region due to smaller population and its geographical location which some islands are very close to China's border.

Next analysis is the employment growth on specialties of the Outer Islands region.

Figure 67 Outer Islands District Specialties and Growths.



Source: *Taiwan National Statistics Bureau*

The highest growth of the larger cluster is Business Services cluster with an over 40% growths. The Hospitality and Tourism cluster has a growth of 10%, and Food Processing and Manufacturing, Water Transportation, and Construction Products and Services have less than 10% growths. The declining cluster is Transportation and Logistics that has close to 10% decline. Performing Arts has a 90% growth rates, but it is a very small cluster and not yet a national concentration.

10. Cluster Analyses and Case Studies

The analyses describe how clusters are performing in Taiwan. Since the dynamics are the factor to be measured, clusters' growth movements are counted. The higher the counts, the higher the movements; therefore, the higher the dynamics. First, the revenue and employment positive growths are considered agglomeration effects, and wage growth is a desirable growth factor for the social measurement according to Porter's theory; therefore, to have all three positive growth rates is the ultimate scenario. This dissertation evaluates all three factors to determine cluster's vitality. With all three factors growing,

which means the business environment has a strong market demand with sufficient labor force and high knowledge or skill labor pool to support the business environment, and this is the best situation. If all three rates are declining, this means the market demand is low, with oversupply of manpower and low skill demand for the labor. The possibilities are listed below in (Figure 68) which can help to interpret the cluster dynamics.

Figure 68 Dynamism by the Growth Rates Interpretations.

Revenue Growth	Employment Growth	Wage Growth	Indication
+	+	+	The cluster is in full momentum.
+	+	-	High market demand with oversupply of labor.
+	-	+	High market demand with undersupply of skilled labor.
+	-	-	The labor skills may be changed for a growing market.
-	+	+	Dropping market demand with sufficient supply of highly skilled labor. This can be in a sustaining phase.
-	+	-	Dropping market demand with oversupply of labor
-	-	+	Dropping market demand with undersupply of highly skilled labor.
-	-	-	The cluster is losing its momentum.

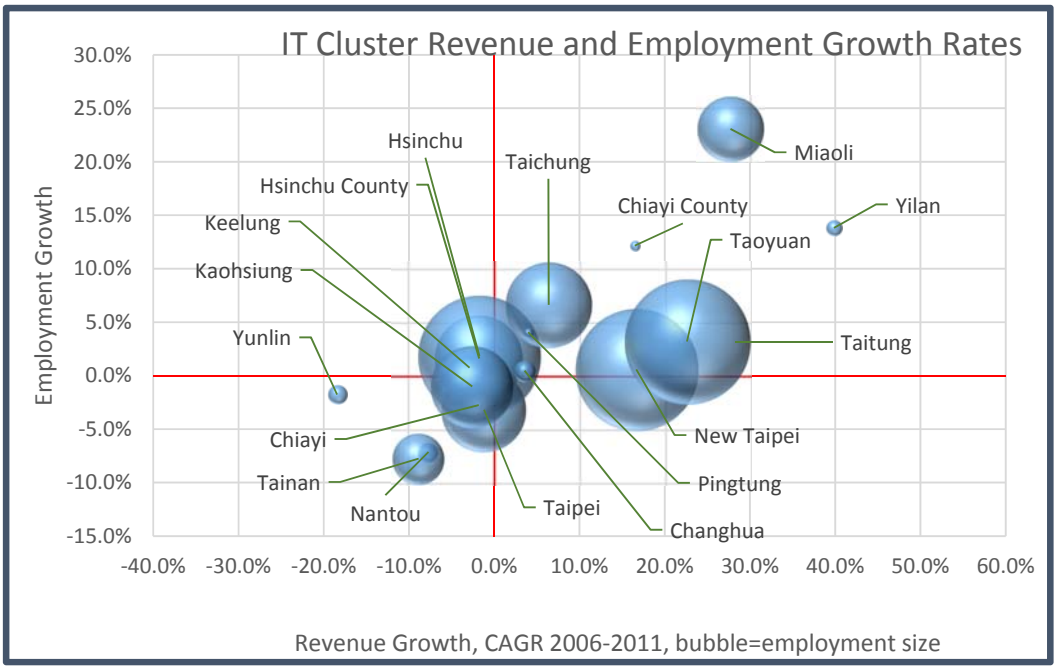
10.1. Two Taiwan's Agglomeration Models

10.1.1. Spillovers Model - IT Cluster

Competitions and innovations are constant challenge for a strong cluster. Local competition helps to improve the quality of product and service delivery. Innovation drives forward the changes. Spillovers potential is calculated with the assumption that the cluster has agglomerated into a strong cluster with a saturation of employment. Previously, the test for the cluster is 5% of a city's employment. Furthermore, the cluster is growing in all three rates, revenue, employment, and wages. The strong growth is providing a condition for the spillovers either the manpower shortage or lack of trained

labor, and a demand for rising revenue. The market demands are driving the employment to go up and wage to rise due to the labor shortage, and the spillover is mostly to spread over to the adjacent locations that is the spillovers of enterprises. The co-location factor makes the spillover a natural shift. Both Taoyuan and Miaoli are good examples of the spillovers from Hsinchu. Hsinchu once reaching its saturation with either very high wage (highest in Taiwan.), or undersupply of labor can lose market shares. More companies will be established in the adjacent cities for the benefit of co-location and spillover effects. We will find the growth rates of adjacent cities on Figure 69.

Figure 69 IT Cluster Growth Map.

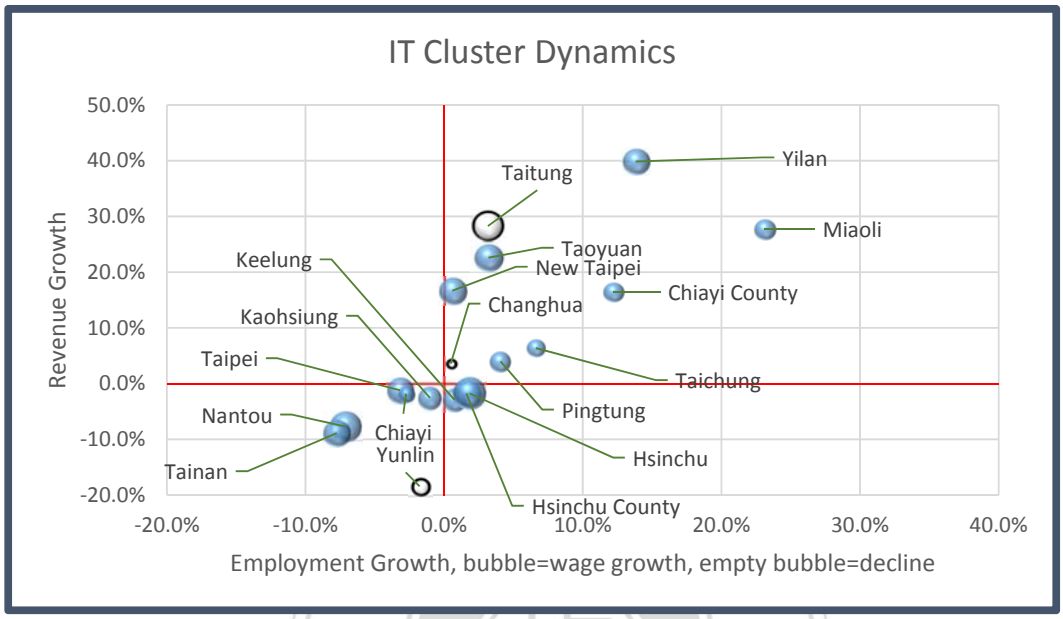


Source: *Taiwan National Statistics Bureau*

IT is a dominated cluster in the Northwest District, and cities within this District are experiencing the spillovers. First take a look at the IT cluster's growth of all cities. IT dominates in Hsinchu and New Taipei. The adjacent cities of Hsinchu are New Taipei, Taoyuan, Miaoli and Taichung. Both Hsinchu City and Country are stagnated in employment and revenue growths. The adjacent city of New Taipei has revenue growth, but stagnate in employment growth. Miaoli the next city with the district is enjoying a

three-dimensional growth. It has the highest employment growth according to the Figure 69.

Figure 70 IT Cluster Dynamics.

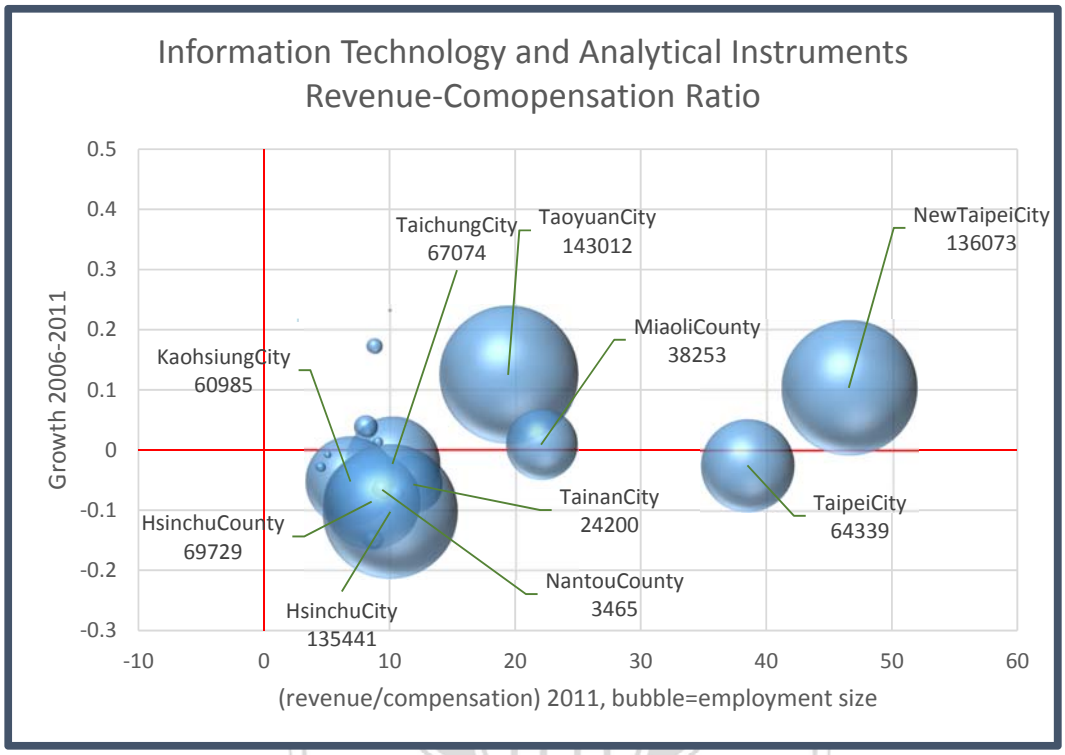


Source: *Taiwan National Statistics Bureau*

From the Figure 70, we see the revenue is also on a high growth as well as the wages. Both Hsinchu cities have declined in revenue. Figure 72 listed all the cities in the co-location adjacencies. We can actually see the spillovers from the highest LQ out to the neighboring cities.

Revenue-to-compensation ratio is often used by businesses owners to gauge labor efficiency. For some researchers use the reverse ratio of compensation-revenue ratio interchangeably that the newer and smaller companies tend to have higher growth rates with a bigger compensation-revenue ratio, but overtime, it improves as the firms expand and sustain successfully. Older firms, in general, slow down on growth (Bracker & Pearson, 1986, p. 517). Here the revenue-compensation ratio is used to represent businesses' profitability as well. A revenue-compensation ratio below tells the rising cities of IT clusters.

Figure 71 Revenue-Compensation Ratio of IT cluster.



Source: Taiwan National Statistics Bureau

Three cities, New Taipei, Taoyuan and Miaoli, are three larger workforce group with high labor efficiency growths in the IT clusters. Both Hsinchu regions with the highest wages are facing efficiency declines with less profits[43]. The adjacent cities' high growth rates are signs of spillovers.

Below list all the factors for the IT cluster:

Figure 72 Spillovers Potential Factors for IT Cluster.

IT Cluster	Wage Growth	Revenue Growth	Employment Growth	Employment Size	Employment Shares	Location Shares	LQ	Wage in NT$1,000
New Taipei	5.1%	16.7%	0.6%	136,073	11.7%	18.0%	1.2	773
Taipei	4.7%	-1.2%	-3.2%	64,339	2.9%	8.5%	0.3	951
Keelung	4.0%	-2.9%	0.7%	1,913	2.8%	0.3%	0.3	582
Taoyuan	5.6%	22.6%	3.2%	143,012	19.8%	18.9%	2.1	717

[43] The revenue-compensation ratio is an indication of labor efficiency. The more efficient labor management can save cost, thus, be more profitable for shareholders.

Hsinchu	5.8%	-1.8%	1.6%	69,729	36.5%	9.2%	3.9	913
Hsinchu City	7.5%	-1.8%	1.8%	135,441	52.7%	17.9%	5.6	1,094
Miaoli	2.9%	27.7%	23.1%	38,253	27.0%	5.1%	2.9	704
Taichung	2.2%	6.4%	6.6%	67,074	7.1%	8.9%	0.8	647
Changhua	-0.7%	3.6%	0.5%	4,181	1.3%	0.6%	0.1	468
Nantou	6.4%	-7.7%	-7.1%	3,465	4.0%	0.5%	0.4	898
Yunlin	-2.4%	-18.4%	-1.8%	2,998	2.6%	0.4%	0.3	508
Chiayi	2.5%	16.5%	12.2%	796	0.9%	0.1%	0.1	425
Chiayi City	1.8%	-1.8%	-2.8%	411	0.7%	0.1%	0.1	568
Tainan	4.8%	-8.9%	-7.8%	24,200	4.6%	3.2%	0.5	695
Kaohsiung	3.9%	-2.6%	-1.0%	60,985	7.8%	8.1%	0.8	658
Pingtung	2.9%	4.0%	4.1%	797	0.6%	0.1%	0.1	421
Yilan	4.8%	39.9%	13.8%	1,932	2.1%	0.3%	0.2	491
Hualien	16.4%	101.7%	40.7%	72	0.1%	0.0%	0.0	790
Taitung	-7.0%	28.3%	3.2%	9	0.0%	0.0%	0.0	276
Penghu	0.0%	0.0%	0.0%	0	0.0%	0.0%	0.0	0
Kinmen	264.2%	648.6%	68.8%	14	0.1%	0.0%	0.0	640
Lienchiang	0.0%	0.0%	0.0%	0	0.0%	0.0%	0.0	0

Source: *Taiwan National Statistics Bureau*

Both Hsinchu City (5.6) and County (3.9) have two highest concentrations and high wage growths especially Hsinchu City with an over 7% growths, and both are facing revenue declines. Hsinchu City, highly specialized with an over 52.7% shares of City employment. New Taipei, Taoyuan, and Miaoli, the adjacent cities demonstrate around 20% growths in revenue, and Miaoli especially has an 23% employment growths. Taichung shows moderate growths but all positive growth rates which indicates the growing momentum is strong, and the LQ is approaching the national level. Both Hsinchu City and County, the hub, is showing a saturation of labor with wage rising rapidly. The drop of revenues indicates the spillovers are shifting to the neighboring cities. The spillovers started from the highest wage of two Hsinchu from 1,094K and 913k spreading to the adjacencies to the lower wage cities (Miaoli of 704k, Taoyuan of 717k, New Taipei, 773k) which confirms the labor pool saturation. The average wages in the three cities clearly confirm the spillover effects. Both Hsinchu City and County are over NT$900,000 in annual wages, and Taoyuan and Miaoli are a bit over NT$700,000.

Hsinchu City has the highest average wages among all cities over NT$ one millions annual average wages. We can also conclude that the spillover starts from the highest wage region and spreads out to the lower wage regions.

Further test needs to see where the spillover stops, going further south to see if Taichung has spillovers to the next city Changhua, and the numbers prove the answer “It stopped at Taichung”. Changhua has employment growths of 0.5% and wages declines of 0.7% in this cluster; despite the revenue growths of 19%, the employment share is a little over 1%, and the wages of NT$467k is way below that of spilling over cities of NT$700k; in the meantime, the LQ is 0.14 which is a very low participation ratio. The conclusion is drawn that the spillovers stop at Taichung. Taiwan’s IT cluster’s empirical case proves the variable relations of spillovers effects. The spillovers slowly spread to the next adjacent location.

The cluster agglomeration takes spillovers into account that, activities naturally spreads over to highly demanded and growing industries, and the knowledge and experiences spills over to other applications or industries. For the research question: What causes spillovers in an industrial cluster? The conclusion is drawn from the above observations:

Spillovers is not a cause; it is an effect.

Spillovers is caused by the shortage of labor. Spillovers occurs when labor pool reaches saturation.

Revenue spillovers happens when employment and wages rise simultaneously in high rates.

Wage rises when labor pool is undersupplied, and if the wages drop, it is an indication of oversupply of labor pool.

The available workforces supplied by the labor pool is a critical factor to trigger the spillover effects. It can impede the revenue growth if labor pool is in shortage.

Wage is an indication for the saturation of the labor pools. When wage rises, it can trigger the spillover effects, especially the wage is much higher than the adjacency locations. Business will try to look for alternatives.

Wage and labor participation are the measures for the labor saturation; the higher the saturation, the more scares of the available labor and higher the wages.

Wages and employment growth are dependent on revenue growth (business income). And the labor supply contextually influences the employment and wages.

Spillovers mostly occur in the knowledge-based industries, which the spillovers occur when the labor pool cannot provide the immediate productive manpower. The productive labor is defined to be the knowledge-based or highly-skilled people, who take more than a year to be trained for the knowledge or skills.

For Taiwan, an annual contract is considered to be a long-term position. This also implies that the shortage of low knowledge and skilled labor supply pool does not trigger the spillovers as long as the labor pool is not saturated, or the labor pool can be fueled from other industries without a long-term training. This summarizes not all industries carry spillover effects, that only those industries require knowledge-based or highly-skilled people can create a spillover effect provided the supply of manpower is not a limit.

Spillovers are inhibited by the higher wages in the adjacent location.

Spillover does not work when the adjacent location has a higher wage than other cities in the same cluster. Taipei provides the proof for this claim. The spillovers will go to the location with a lower pay such as Taoyuan and Miaoli with available labor pools and lower wages. Besides, Taipei has an average of NT$950k, the second highest of all cities. With LQ of 0.3 means there is better pays for other jobs than the IT jobs in Taipei. In other words, people have more choices to select from.

LQ can be a gauge for a location that is ready for spillovers. When a cluster has a low LQ (much lower than 1), the location has not developed the labor pool needed for spillovers; then the location will not be the candidate for the spillover. Changhua is the case for IT cluster with a LQ of 0.1 with a very low location shares of 0.6%. Taichung has a LQ of 0.8 which is close to the specialization qualification of 1 and much higher location shares of 9% with all three growth rates are positive; this means that Taichung is receiving spillovers most likely from both Hsinchu City and County since both have

revenue drops in the IT cluster. This is a clear case of revenue spillover with both wages and employment rising with high percentages in both Hsinchu.

From the observations, the cluster spillover theory is enhanced with the following properties:

1. The revenue is market demand driven in an open free market.

   The market demands trigger the need for solving important societal demands, which requires high knowledge or difficult skills for the solutions, and the solution will serve a mass market.

2. The mass market means the solution impacts many lives.

3. The solution requires time and money to invest in final deliveries to solve societal demands, and the investment will generate returns in profits for the funds infused.

   For example, making a toothbrush is not a challenge technically or requires difficult skill set, but making comfortable shoes can be challenging since it requires the experience and skills to make good moldings for the curves of feet to make them comfortable for many people. Italian's shoe industry demonstrates this expertise. Flora Holland created a high-tech logistics system from a farming industry into a sophisticated floral trading platform to meet the floral market's demands. They are not short of flower growers in the world, and flowers can be very cheap in some parts of the world to create a price competition. FloraHolland faced the price-cut competition severely years ago, and designs a turnkey solution to overcome the problem. Their turnkey solution requires a team of skillful people to design and maintains a complex and the world-class logistics system and trading platform. It delivers the freshest flowers to anywhere in the world from any growers in the world. Any growers may join the platform to sell their flowers and benefit from the fairest commission for the logistics and selling. This type of system takes knowledge, experience, and technology to solve the problem of pricing competition. People who work in the industry have converted from a local grower to an international flower provider. The flower cluster soon agglomerates in Holland and internationally. The demand for the labor pool has gained varieties of job backgrounds such as computer scientists, logistic managers, and trading analysts. Soon Flora Holland established more sites within Holland and other places in the world. The trainings go along with the system is important too, so that FloraHolland is not short of labor to expand their businesses. At the end, the business agglomerated internationally.

4. Both wage and employment are influenced by the labor pool supplies. Undersupply of manpower can cause the wage to go high, and oversupply of manpower can cause the wage to go down. The labor pool supply can also directly influence the employment to go high or low depending on the supplies.

5. Cluster spillovers are the works spreading to the adjacent location with available labor pools.

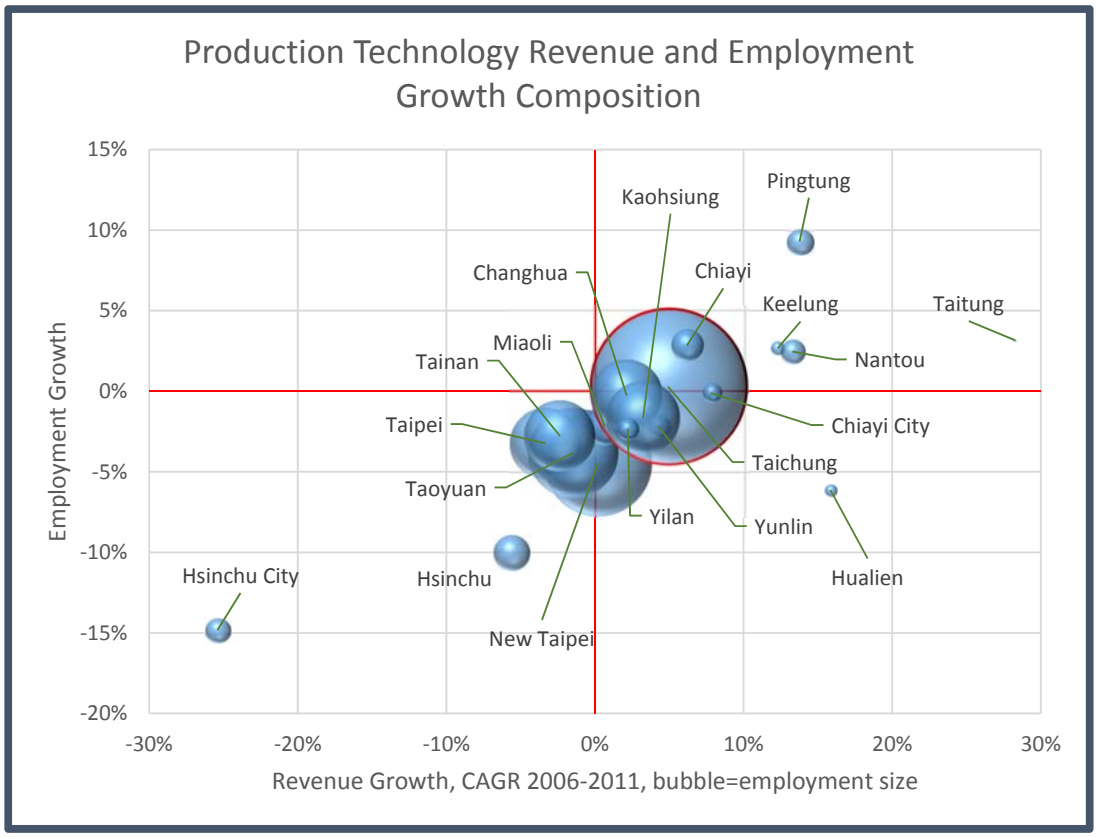
10.1.2. Supply-Chain Migration Model - Production Technology and Heavy Equipment Cluster

The supply-chain migration is a confined pool of people who move with a leader to form another set of supply-chain, which the location can be somewhere far away with more resources and available labor supplies. This is normally done by the availability of lower cost labor pools. An example, Foxconn led suppliers to build a supply-chain by building another similar cluster in China migrated from Taiwan. This is not a spillover effect because the wage factor is a reverse condition. In this case, the labor pool is no longer contextually influencing the wages because of the cause of the available lower paid workforce is not the same labor pool when the migration of the supply-chain happens. The migration model is a totally different model from the spillover model when it comes to setting up the variables for observations. The supply-chain model is a cost-driven model that the low cost drives the mass production to be available for an existing market. The solution does not necessarily solve a societal problem. It stimulates the market to buy a cheaper product. As matter of fact, there is no spillovers since there are available labor pools with low cost labor to use. The supply-chain migration normally migrates to under developed countries. To differentiate the two types, one is top-down, supply-chain migration with planning involved. And the other type is the bottom-up, demand-driven with the saturation of the labor pool. They are two very different models, and the big difference is the wage growth.

Figure 73 is the revenue and employment growths map for the Production Technology cluster. Taichung is the dominate city for this cluster. Changhua, Tainan, Kaohsiung, Taipei, New Taipei all have high labor shares in this cluster. From the dynamics, Only Taichung and Chiayi has all positive growths. Hualien has a very high wage growth but declines in employment indicating the undersupply of labor. Since Taichung is still growing in full momentum, and it has not reached a saturation yet. Both Hsinchu Cities are definitely phasing out of this industry with all growth rates declining. Taitung has the

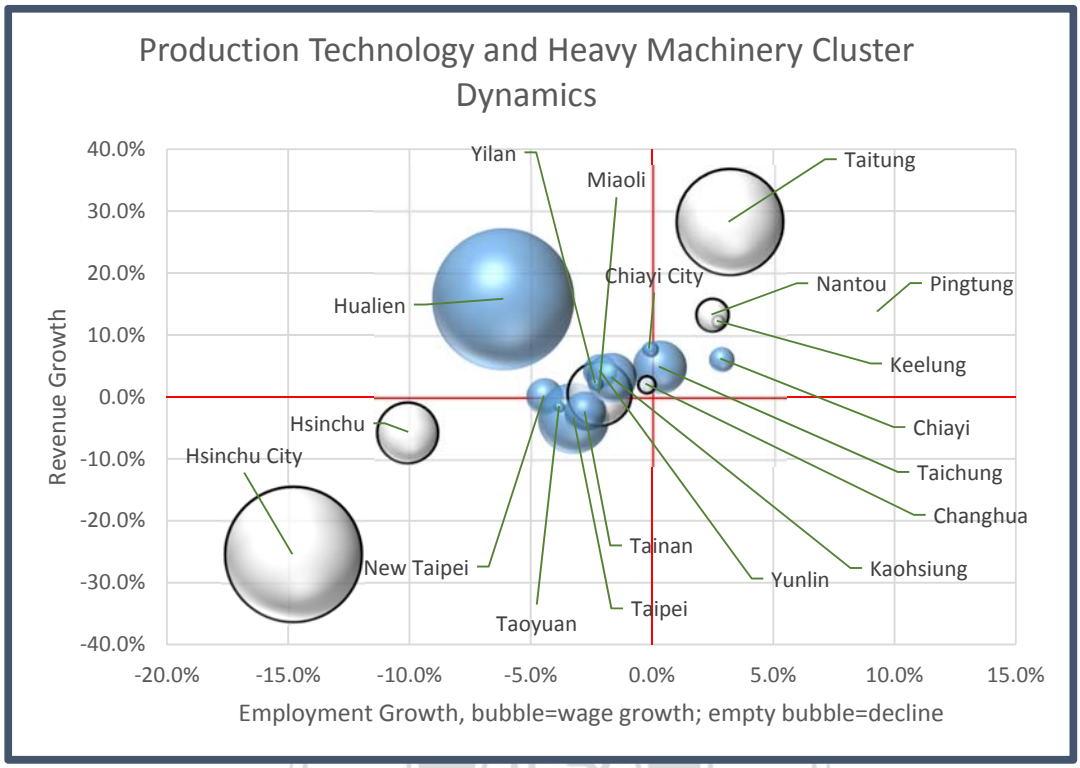
oversupply of labor since the wage is dropping but employment and revenue all risings. Compare the two highly specialized cities Taichung and Changhua, Taichung is doing better than Changhua that Taichung is with all growths and Changhua has wages and employment declines.

Figure 73 Production Technology and Heavy Equipment Revenue and Employment Growths.



Source: *Taiwan National Statistics Bureau*

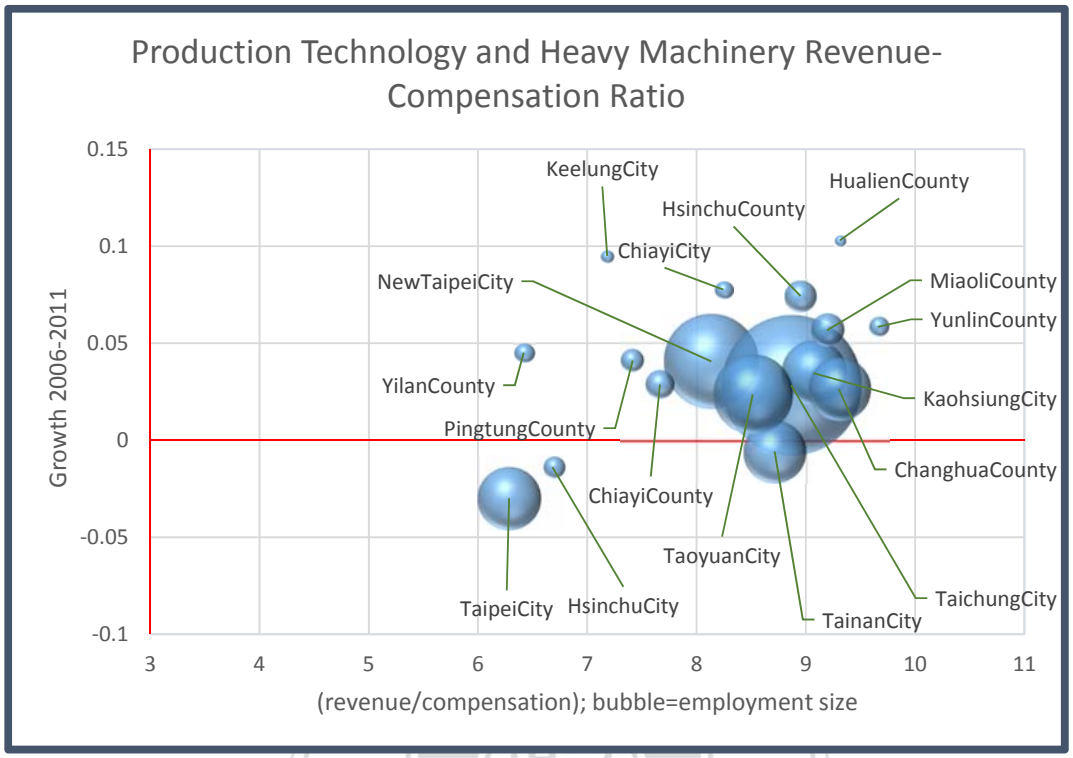
Figure 74 Production Technology and Heavy Machinery Cluster Dynamics.



Source: *Taiwan National Statistics Bureau*

National Chengchi University

Figure 75 Production Technology and Heavy Machinery Labor Productivity.



Source: Taiwan National Statistics Bureau

Followed by list of agglomeration factors.

Figure 76 Production Technology Cluster Growth Composition.

Production Technology Cluster	Wage Growth	Revenue Growth	Employment Growth	Employment Size	Cluster Shares	Location Shares	LQ	Annual Average Wage in NT$1,000
New Taipei	0.8%	0.2%	-4.5%	33,567	2.9%	15.9%	1.1	483
Taipei	3.0%	-3.3%	-3.2%	14,686	0.7%	6.9%	0.3	818
Keelung	-0.1%	12.3%	2.7%	508	0.7%	0.2%	0.3	438
Taoyuan	0.1%	-1.5%	-3.8%	23,689	3.3%	11.2%	1.2	528
Hsinchu	-2.4%	-5.7%	-10.1%	3,662	1.9%	1.7%	0.7	583
Hsinchu City	-11.2%	-25.4%	-14.8%	1,733	0.7%	0.8%	0.3	506
Miaoli	-2.6%	0.7%	-2.2%	4,094	2.9%	1.9%	1.1	460
Taichung	1.7%	4.9%	0.3%	73,140	7.8%	34.6%	2.9	485
Changhua	-0.2%	2.1%	-0.3%	14,744	4.6%	7.0%	1.7	374

Nantou	-0.7%	13.3%	2.5%	1,631	1.9%	0.8%	0.7	395
Yunlin	0.7%	4.3%	-2.2%	1,479	1.3%	0.7%	0.5	343
Chiayi	0.4%	6.2%	2.8%	3,067	3.6%	1.5%	1.4	432
Chiayi City	0.2%	7.8%	-0.1%	1,076	1.8%	0.5%	0.7	373
Tainan	1.0%	-2.4%	-2.8%	14,762	2.8%	7.0%	1.1	425
Kaohsiung	1.5%	3.2%	-1.7%	15,807	2.0%	7.5%	0.8	481
Pingtung	0.0%	13.8%	9.3%	1,976	1.6%	0.9%	0.6	415
Yilan	0.1%	2.2%	-2.3%	1,371	1.5%	0.6%	0.6	420
Hualien	11.9%	15.8%	-6.1%	394	0.7%	0.2%	0.2	693
Taitung	-7.0%	28.3%	3.2%	9	0.0%	0.0%	0.0	276
Penghu	0.0%	0.0%	0.0%	0	0.0%	0.0%	0.0	0
Kinmen	0.0%	0.0%	0.0%	0	0.0%	0.0%	0.0	0
Lienchiang	0.0%	0.0%	0.0%	0	0.0%	0.0%	0.0	0

Source: *Taiwan National Statistics Bureau*

Taichung dominates the Production Technology with 35% of total cluster's workforce. This is a cluster requires special skills and production knowledge, in the meantime, this is a capital-intensive industry. Taichung is doing rather well through financial crisis that all three growth factors are positive. Figure 75 shows the clustered cities share similar revenue-compensation ratios (Taichung, Changhua, New Taipei, Taoyuan, Kaohsiung, Tainan). Three productivity declining cities are Taipei, Hsinchu City, and Tainan. Both Hsinchu City and County are especially losing all three growths in large declines, and the profitability remain lower than the clustered cities.

Unlike the IT clusters, the spillovers are not reflected by the wage growth. In this cluster, the dominated city, Taichung, does not have the highest wages, and it appears to have the capacity to continue to be the leader in this industry. The field surveys indicate that most companies are small and matured factories with steadily growth businesses over twenty years. Many factories receive orders from semiconductor industries and other production industries and have established sites in China or Southeast Asia. Furthermore, they are not able to find higher skilled local workers, and most of them are hiring migrant workers for the production work which means the work can be trained to non-skilled workers. Finding the right employees to hire has been an issue for them. The supply-chain migration model demonstrates the wage effect is different from the spillover model. Education development can be done with cluster initiatives to boost the employment supply in this case.

10.2. Taiwan's Biotech Initiative – a case study

The Biopharmaceutical and Medical Devices cluster has been one of six Taiwan's Economic Development Policy since 2009. Although they are grouped into the same industry, but their clustering is different. The Industrial Development Bureau (IDB) has produced a white paper on the economic policy of Taiwan's biotechnology industry (Industrial Development Bureau, 2015). The white paper provides a thorough research and planning details of each targeted industry. It pointed out one weakness which is the marketing. Taiwan has been focusing on research and development, but is short on marketing strategies from rolling out products to market acceptance. The recent plan believes Taiwan is ready for investments into the industries (Industrial Development Bureau, 2015, p. 324).

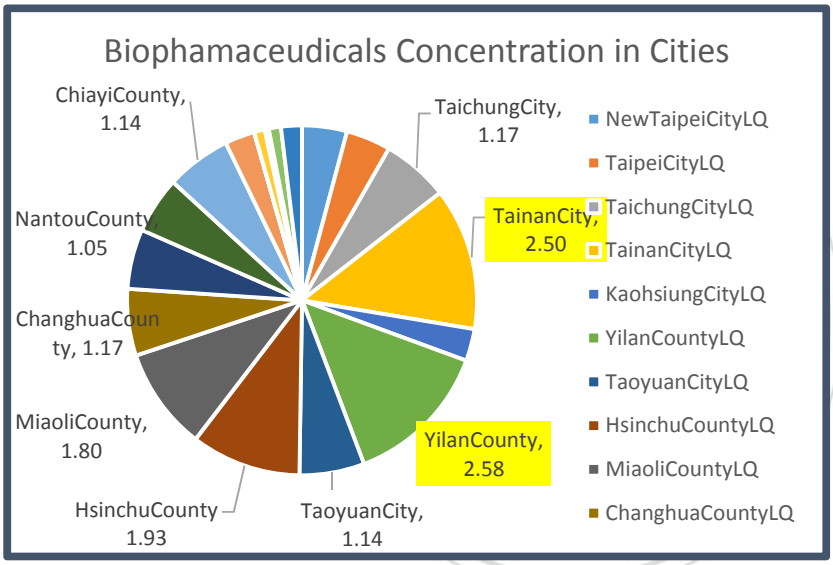
This industry may face development strategy issue against the international community. One of the debatable issues is the genetic altering food although may claim to reduce environmental damage but may create health issues recently. The European policy has set clear goals, and one of them is food safety (Ding, 2015). "The Bioeconomy Strategy aims to improve the knowledge base and foster innovation to achieve productivity increases while ensuring sustainable resource use and alleviating stress on the environment." states EU's primary goal. (European Commission, 2012, p. 12) Different from Taiwan's policy goals that EU starts to define the problem and tackling the problem with strategies by forming a clear goal request for initiatives to meet the goal. The EU Commission planning document starts with the statement "This strategy proposes a comprehensive approach to address the ecological, environmental, energy, food supply and natural resource challenges that Europe and indeed the world are facing already today." (European Commission, 2012, p. 6)

Taiwan's white paper focuses on the technological research. It avoids the discussion on market demand and problem solving perspective. Part of document supports genetic engineering which is debatable nowadays. (Industrial Development Bureau, 2015, p. 4) If a product is ready for marketing, it may be rejected by the EU market if the product contains genetic engineering process. Both European and American white papers set goals to increase jobs as a top priority (*National Bioeconomy Blueprint*, 2012, p. 1), and

both have addressed the pathways to the workforce participation (European Commission, 2012, p. 14; *National Bioeconomy Blueprint*, 2012, pp. 33-38). Taiwan's Bioeconomic plan puts more emphasis on elite incubation and has not addressed the workforce participation, nor has set clear goals of how to reach the employment mass. The recent cluster mapping data reflects the shortage.

Both Biopharmaceuticals and Medical Devices have workforce participation of 0.3% in overall workforce. Below charts display both cluster specializations in the cities. These two clusters have different specialties, therefore, should be reviewed separately.

Figure 77 Biopharmaceutical's Concentration in Cities.



Nine cities specialize in Biopharmaceuticals, and two are highly specialized.

Source: *Taiwan National Statistics Bureau*

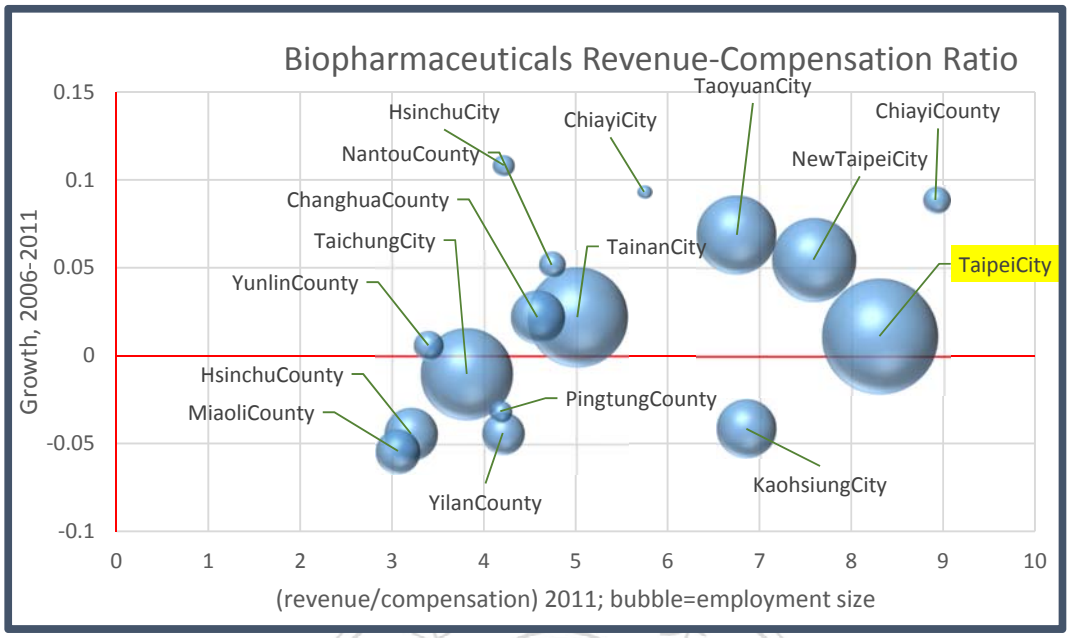
Below is the Biopharmaceutical Growth Composition.

Figure 78 Biopharmaceutical Growth Composition.

Business Services	Employment Growth	Revenue Growth	Wage Growth	Employment Size	Employment Shares	Location Shares	LQ	Annual Average Wage in NT$1,000
New Taipei	7.2%	30.1%	15.1%	2,919	0.3%	11.4%	0.8	997
Taipei	4.5%	7.1%	1.4%	5,558	0.3%	21.7%	0.8	889
Keelung	30.9%	118.6%	6.6%	15	0.0%	0.1%	0.1	547
Taoyuan	2.6%	11.4%	1.6%	2,624	0.4%	10.2%	1.1	643
Hsinchu	-5.0%	-15.5%	-7.0%	1,180	0.6%	4.6%	1.9	597
Hsinchu City	2.7%	11.6%	-2.0%	174	0.1%	0.7%	0.2	263
Miaoli	24.4%	16.4%	-1.0%	815	0.6%	3.2%	1.8	575
Taichung	3.1%	4.0%	1.9%	3,527	0.4%	13.8%	1.2	621
Changhua	1.7%	2.8%	-1.2%	1,210	0.4%	4.7%	1.2	374
Nantou	7.1%	4.9%	-6.9%	290	0.3%	1.1%	1.0	241
Yunlin	11.5%	4.7%	-6.6%	365	0.3%	1.4%	1.0	317
Chiayi	5.5%	3.7%	-9.8%	309	0.4%	1.2%	1.1	220
Chiayi City	-0.2%	25.0%	14.5%	70	0.1%	0.3%	0.4	511
Tainan	2.8%	6.0%	1.0%	4,159	0.8%	16.2%	2.5	541
Kaohsiung	4.9%	2.1%	1.6%	1,415	0.2%	5.5%	0.6	394
Pingtung	1.4%	-0.2%	1.6%	207	0.2%	0.8%	0.5	383
Yilan	-0.6%	-0.6%	4.6%	749	0.8%	2.9%	2.6	540
Hualien	40.7%	101.7%	16.4%	36	0.1%	0.1%	0.2	790
Taitung	0.0%	0.0%	0.0%	0	0.0%	0.0%	0.0	0
Penghu	0.0%	0.0%	0.0%	0	0.0%	0.0%	0.0	0
Kinmen	0.0%	0.0%	0.0%	0	0.0%	0.0%	0.0	0
Lienchiang	0.0%	0.0%	0.0%	0	0.0%	0.0%	0.0	0

Source: Calculation from Taiwan Census Data, Taiwan National Census Bureau

Figure 79 Biopharmaceuticals Revenue-Compensation Ratio.

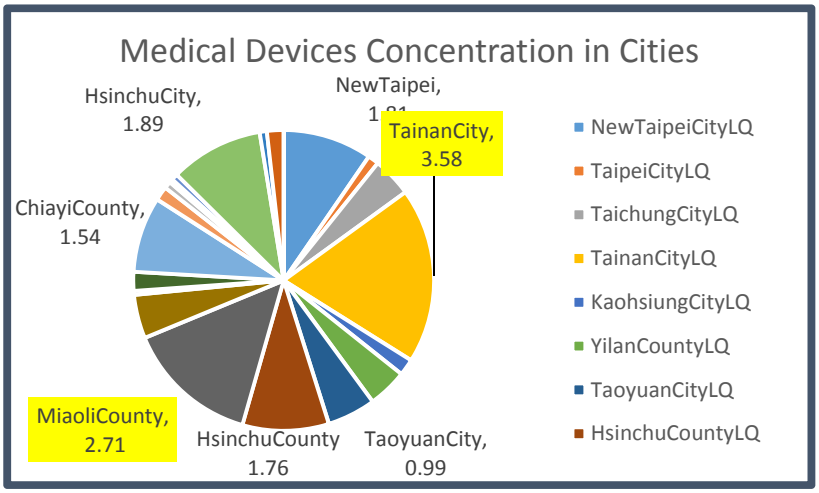


Source: Taiwan National Statistics Bureau

For Biopharmaceuticals, Taipei and Tainan are the two largest workforce with full growths, but Tainan is more specialized than Taipei. Hsinchu being one of three most highly specialized cities are facing a full decline in all rates. Yilan has revenue and wages decline. Other specialized cities (Taoyuan, Taichung, Changhua, Chiayi County) are growing healthy but with smaller rates. Miaoli is growing on high rates over 20% but employment decline which indicate labor shortage. Tainan remains strong among the highly specialized cities. The Biopharmaceuticals cluster is still early in the development stage. Unlike the IT cluster with a high profit, New Taipei, Taipei, Taoyuan, and Tainan are larger and have better revenue-compensation ratio almost equivalent to the Production Technology cluster. Taipei appears to be more productive than Tainan.

Below is the discussion on the Medical Devices cluster.

Figure 80 Medical Devices Concentration in Cities.



Biopharmaceuticals and Medical Devices' specialized clusters overlaps in five cities, and they are Taoyuan, Hsinchu County, Miaoli, Tainan City, Chiayi County with only one highly specialize cities fully overlap, Tainan.

Source: *Taiwan National Statistics Bureau*

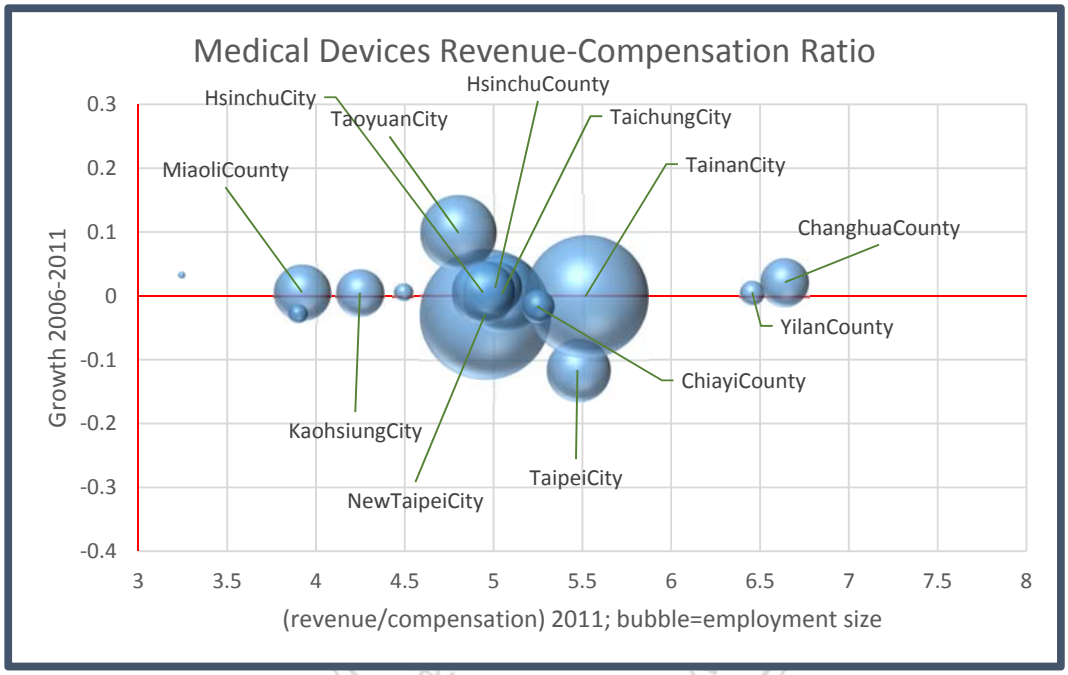
Figure 81 Medical Devices Growth Composition.

Business Services	Employment Growth	Revenue Growth	Wage Growth	Employment Size	Employment Shares	Location Shares	LQ	Annual Average Wage in NT$1,000
New Taipei	8.8%	9.9%	4.0%	6,668	0.6%	26.2%	1.8	543
Taipei	0.5%	-12.2%	-1.2%	1,582	0.1%	6.2%	0.2	554
Keelung	-3.7%	-9.9%	5.8%	29	0.0%	0.1%	0.1	491
Taoyuan	7.2%	23.5%	4.9%	2,262	0.3%	8.9%	1.0	422
Hsinchu	6.8%	8.7%	0.5%	1,065	0.6%	4.2%	1.8	511
Hsinchu City	15.6%	10.9%	-4.5%	1,543	0.6%	6.1%	1.9	517
Miaoli	43.1%	51.3%	5.2%	1,219	0.9%	4.8%	2.7	508
Taichung	16.7%	22.5%	4.7%	2,401	0.3%	9.4%	0.8	470
Changhua	18.2%	15.7%	-4.1%	915	0.3%	3.6%	0.9	328
Nantou	-33.9%	-52.0%	-5.0%	22	0.0%	0.1%	0.1	314
Yunlin	30.0%	46.5%	15.8%	141	0.1%	0.6%	0.4	590
Chiayi	4.5%	4.8%	2.0%	414	0.5%	1.6%	1.5	392
Chiayi City	-5.4%	16.2%	2.6%	28	0.0%	0.1%	0.1	368
Tainan	6.6%	7.5%	0.9%	5,906	1.1%	23.2%	3.6	353
Kaohsiung	5.0%	6.5%	1.0%	840	0.1%	3.3%	0.3	434
Pingtung	3.5%	2.6%	-1.5%	113	0.1%	0.4%	0.3	279
Yilan	-16.3%	-15.0%	0.9%	230	0.3%	0.9%	0.8	440
Hualien	-2.8%	-17.6%	-7.3%	14	0.0%	0.1%	0.1	232

Taitung	-7.3%	-10.1%	-6.2%	13	0.0%	0.1%	0.1	252
Penghu	0.0%	0.0%	0.0%	0	0.0%	0.0%	0.0	0
Kinmen	7.3%	24.9%	18.8%	14	0.1%	0.1%	0.3	640
Lienchiang	0.0%	0.0%	0.0%	0	0	0	0.0	0

Source: Calculation from Taiwan Census Data, Taiwan National Census Bureau

Figure 82 Medical Devices Revenue-Compensation Ratio.



Source: Taiwan National Statistics Bureau

New Taipei and Tainan cities are the two largest workforce and with full growths. Other full growing cities include Taoyuan, Hsinchu County, Miaoli, and Chiayi. Many IT high growth cities overlap with the Medical Devices clusters such as New Taipei, Taoyuan, Miaoli, Hsinchu, Hsinchu City. Miaoli has a 43% growths on employment. Taichung and Changhua are also showing high growths on employment and revenue but not specializing in the cluster, and the revenue-compensation ratio is lower than the Production Technologies and Tools (see Figure 82). This is an indication that the Production Technology industry is a supportive industry to this cluster. Out of the two largest workforce participation cities, New Taipei and Tainan, Tainan is much more specialized and profitable than New Taipei.

To put the two clusters together, Tainan appears to be most specialized and profitable. Of course, New Taipei and Taipei are close in distance which has the most workforce participation, it's labor efficiency is not as good as Tainan. Tainan is a remote area, since these two clusters are still in an inception phase, more needs to be planned for the growth of Biotechnology industry. One of the weaknesses that Taiwan's White Paper points out is the marketing specialty. This is an area that the industry needs a booster which the White Paper (Industrial Development Bureau, 2015, p. 270) is trying to address and lack of strategy for the development supports. The Business Services cluster is growing very rapidly in Taiwan, and education and training plan can be made to connect the clusters so that there are professionals trained workforce ready for these industries. Since the Bioeconomy is new and in its infancy in Taiwan, it can borrow the traditional clusters' strengths to help to develop its new strengths. Taipei and Tainan, each can be analyzed by its strengths and weaknesses.

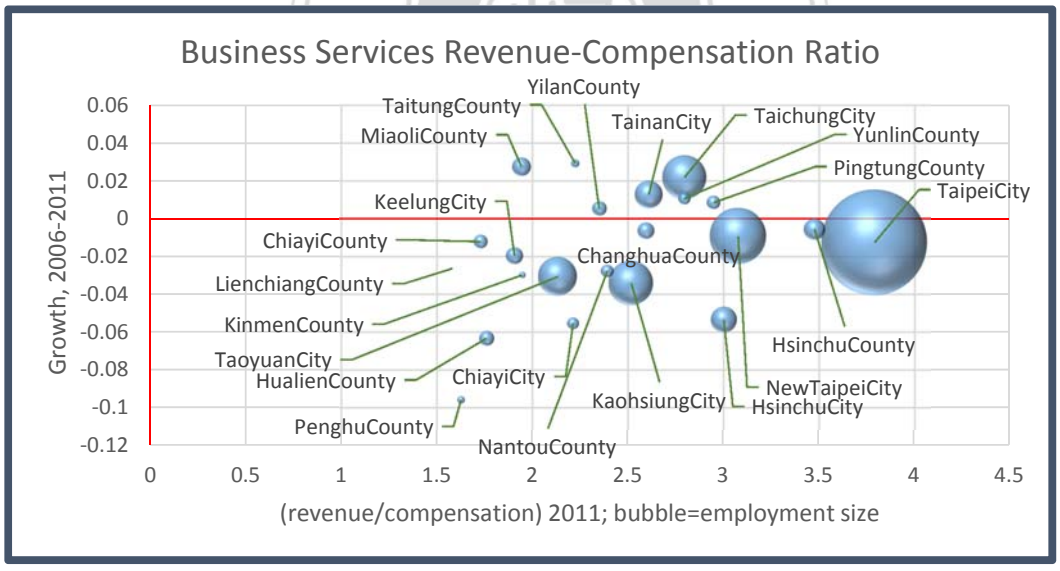
Taipei and New Taipei have several medical research institutes which specialize in pharmaceutical research, and the international business support is stronger in the North districts. Taiwan is more suitable for the Medical devices since it is closer to the Production Technology hub of the Middle district. Tainan can be in Nutraceuticals focus for the following reasons.

First, Tainan has been a traditionally farming and fishing region that provide researchers natural resources to some of the research. Second, Tainan has University Research Centers nearby focusing on medical research, and this can complement the research setup and knowledge transfer. Third, Tainan has one of the largest food processing companies, that the food processing technology can be utilized. Fourth, Tainan in the earlier time was famous for textile manufacturing and has developed Production Machinery specialty in case of needing to develop new production machinery. Five, the newly developed Tainan Technology Park provides policies and environment for innovation and research development. With these advantages, the Biotechnology combing Food Processing can accommodate the new clusters by the available local specialties. Tainan can be a candidate to become a Bioeconomy cluster center; therefore, a cluster initiative can be formed to encourage stakeholders to participate in the regional development.

10.3. Business Service Cluster Development Potential

Business Services cluster throughout the analysis has shown a growth path in all cities, and the cluster has not agglomerated strong enough to form its specialization in cities; only three in the main island are specialized, Taipei, Keelung, and Hualien. The cluster is on a growing trend, and Taipei has the largest workforce for this cluster. Despite the growth, only four cities have growing wages. Only Chiayi has revenue decline, and Tainan has employment decline (see Figure 83). The revenue-compensation ratio indicates a much lower labor efficiency compared to the production based clusters, which is normal (The Goldman Sachs Group, 2011; Todrin, 2011), but the wage growth rates are not very encouraging despite the revenue growth is very positive across the board. Only Tainan has employment decline and wage rising. The average wages in general are lower than the Production industries. More skill and knowledge training base on market demand can be designed to be a better supportive industry.

Figure 83 Business Services Revenue-Compensation Ratio.



Source: Taiwan National Statistics Bureau

Below is a list of important growth factors for the Business Services Cluster:

Figure 84 Agglomeration Factors for Business Services Cluster.

Business Services	Wage Growth	Revenue Growth	Employment Growth	Employment Size	Employment Shares	Location Shares	LQ	Annual Average Wage in NT$1,000
New Taipei	-5.5%	9.2%	16.6%	56194	4.8%	13.2%	0.9	435
Taipei	-0.8%	4.6%	6.8%	197006	8.9%	46.3%	1.7	620
Keelung	-9.3%	18.7%	33.5%	5168	7.5%	1.2%	1.4	327
Taoyuan	-4.2%	11.3%	19.8%	26809	3.7%	6.3%	0.7	367
Hsinchu	-0.3%	9.3%	10.2%	8063	4.2%	1.9%	0.8	491
Hsinchu City	1.6%	0.1%	4.1%	11929	4.6%	2.8%	0.9	584
Miaoli	-1.0%	8.4%	6.6%	6236	4.4%	1.5%	0.8	323
Taichung	-2.0%	10.0%	9.9%	34336	3.6%	8.1%	0.7	427
Changhua	3.4%	5.4%	2.6%	4947	1.5%	1.2%	0.3	408
Nantou	-3.9%	11.3%	19.1%	2919	3.4%	0.7%	0.6	351
Yunlin	0.3%	15.5%	13.9%	2674	2.3%	0.6%	0.4	396
Chiayi	-0.3%	15.4%	17.2%	3432	4.0%	0.8%	0.8	391
Chiayi City	-2.0%	-1.7%	6.2%	2559	4.3%	0.6%	0.8	379
Tainan	0.9%	1.5%	-0.7%	13717	2.6%	3.2%	0.5	398
Kaohsiung	-3.5%	6.8%	14.6%	34961	4.4%	8.2%	0.8	372
Pingtung	-3.6%	13.7%	17.0%	3354	2.7%	0.8%	0.5	361
Yilan	-5.1%	14.7%	20.3%	3729	4.1%	0.9%	0.8	349
Hualien	-3.3%	11.1%	22.7%	4003	6.7%	0.9%	1.3	391
Taitung	1.8%	13.9%	8.7%	1180	4.1%	0.3%	0.8	356
Penghu	-2.0%	40.1%	58.1%	1025	6.9%	0.2%	1.3	362
Kinmen	-9.0%	15.8%	31.2%	748	5.9%	0.2%	1.1	310
Lienchiang	-11.2%	39.9%	61.8%	111	5.7%	0.0%	1.1	274

Source: *Taiwan National Statistics Bureau*

The growth factors are performing surprisingly well during the financial crisis. Although the wages are low and declining, employment growth rates are almost positive except for Tainan City, and Chiayi City is the only cities have revenue decline. This is an indication the Business Services cluster is well with plenty of labor supplies available. Obviously there is a leader in this cluster that is Taipei City where central government and financial institutes reside. Most city wages are still in a low level that allows room for development. This cluster has the sub-clusters of Corporate Headquarters, Consulting Services, Business Support Services, Computer Services, Employment Placement

Services, Engineering Services, Architectural and Drafting Services, and Ground Passenger Transportation. The growth indicators show that theses sub-sector services are in a broad demand by all cities. This is where education program can be set to encourage the development of each service category for the agglomeration of the cluster. Taiwan compares to the US, the service industries are still at its early developmental stage. An initiative may be planned for the agglomeration of this cluster. More education can be put into emphasis to cover the weakness of Taiwan's marketing experience and to provide full research on service science study.

More detail regional analyses are provided in Appendix - Regional Level Economic Analysis and other cluster analyses are in Appendix Other Cluster Analyses. A web program has been developed for the dynamic display. The software tool is designed for all users to examine in details how each city or district dynamism develops and can further design their cluster initiatives to contribute to the economic development for Taiwan.

11. Research Summary

On the qualitative analysis, the study is to address the policy delivery effectiveness issue. To address the closing gap between policy makers and people, a comparative study has been done on the cluster initiative decision models. Taiwan, EU, and US was assessed to make the differentiation how economies drive their cluster initiatives. The three models came out differently, Taiwan is the top-down model, EU is the bottom-up model, and the US have the interactive model. Taiwan focuses on technology excellence by encourage innovations. The EU sets their shared vision on solving important human issues for a better living environment, and EU has an observatory platform for everyone to use for their industrial cluster initiatives. The US has the cluster mapping tool released by the Commerce Department to create jobs by utilizing the latest regional cluster information. The US model currently solves a bottleneck problem of knowledge sharing, which is the world current technological shortfall, too much information and lack of organizations.

For the quantitative analyses, the research defines Taiwan's cluster code for the calculation of growth rates and redefines Taiwan's economic districts based on the

regional specializations. A digit-sliced evaluation tool is designed to evaluate the dynamics of regional and cluster analyses. The economic landscape then is derived from the clustered specialties. By analyzing revenue, employment and wages growth rates, the researcher derives the dynamic landscape of the five-year census data from 2006-2011. The employment shares give the clustering information on industries, and city and districts are defined based on the clustering effects. Revenue growth tells how well a cluster is doing after an external shock. Wage and employment growths are indicators on the labor pool demand and supplies. From Taiwan's growth dynamics, a dominated cluster is identified, Information Technology and Analytical Instrument, demonstrating the spillovers of employment by the rising wages.

Through the inductive research, Taiwan's industries are identified with two models of industrial agglomeration. One is the spillover model, and the other one is the supply-chain migration model. The two models have different wage growth patterns. The spillovers' model has the wage growth rising with the dominate city leading the highest wages and spreading employment out to the lower-waged adjacent cities. On the other hand, the supply-chain migration model shows a cluster of similar strong clusters with growth rates running in parallel, and the wages is very close among the specialized cities. There is no leader in wages nor the wages are rising sharply.

IT industry has the knowledge-based spillovers model and the highest cluster salary from Hsinchu area. The dominated cluster attracts over 50% of workforce in the region and spreads over to the neighboring regions from north to south stopping at Taichung. The supply-chain migration model has machine tooling industries (Production Machinery and Heavy Equipment and among other Metal Working Technology, etc.) concentrating in the middle region especially clustered in Taichung and Changhua cities. The strong (over 5% workforce participations regionally) clusters are growing in a similar pace. The field surveys confirm the findings that many enterprises receive orders from the IT industry, and many have factories in China or Southeast Asia for lower labor cost and make export diversions to compensate the lack of FTA problems in Taiwan. The local regions have difficulty attracting workforce participation due to industry upgrade and lack of skilled

workers. The revenue-compensation ratios show that the wage in the Machine Tooling industries are much less than the IT industry.

Through the regional and cluster analyses, industrial dynamics are identified with some alarming facts. One alarming phenomenon throughout Taiwan is that the downstream products such as Downstream Metals, Wood, Furniture, Footwear products are facing stringent market competitions are facing steep declines despite the upstream manufacturing are growing. This impact all regions especially the production regions from the middle regions southward. The dynamic assessment from the cluster growths indicates the Downstream Metal Product cluster having the revenue declines and the employment declines in almost all cities (See Figure 153). This means the market competition is causing the declines for Taiwan. On the other hand, for the Transportation and Logistics cluster, the revenue and wages are all rising, but the employment rates are all declining (Figure 154); this is an indication of labor pool shortage. The transportation industry is booming due to the web order merchandizing. Every country with web access are recruiting shipping staff, and Taiwan's low wage has lost on the labor competition in this case.

One noticeable cluster is the Business Services which is growing in revenue and employment across the board mostly from north to south, spreading throughout the main island and outward, and the wage is still low and declining with less revenue-compensation ratio about three times. This is an indication that the Business Services industry is in demand, and the labor pool is not saturated, but the service skills have not reached the knowledge demanded professional base. In the meantime, this cluster has not reached the specialization level in many cities. More development can be done to elevate the quality of labor pool in this cluster.

Some small clusters are growing but still very specializing and small such as Biopharmaceuticals and Medical Devices (less than 3% total combined in employment shares). A case study is done on Taiwan's Bioeconomy since this industry has been on the policy maker's list to incubate, but has not reached prosperity yet. The cluster map has derived two regions in this industry. The North district (Taipei and New Taipei) of Taipei regions has more research institutes working on pharmaceutical research and has

the most populated workforce in this region. For the Southwest region, especially Tainan has good potentials for the expansion of Nutraceuticals and Medical Devices clusters utilizing the local specializations of food and textile production machine tooling industries. The local specialized production machinery industry and the science park can provide the complementary supports to the knowledge and skill development for the labor pools. The capacity is still available and open in the area. This is where policies may help in terms of aiding the embryonic incubation.

The outer islands are segregated and isolated in general and not correlated with the main island's growths, therefore, is studied separately. The outer islands are primarily military based and are active in tourism due to the open trade agreement with China. The risk of instability is high due to its political dependency. One cluster on the rise is the Aerospace Vehicle cluster in Kinmen which may help to create local specialization and employment. The Business Services cluster is rising as well, and more education training can be provided throughout regions.

12. Conclusion

Current economic policy in Taiwan failed to address issues of economic growth. A tool created to bridge the gap between policy makers and people can be the first step to collaborate initiatives for Taiwan's economic development. Taiwan is the subject of this research, and the goal is through data-driven industrial cluster analyses to develop a tool to unite people who is interested in economic development in policy making, business trades and services, and research to use and conclude with findings and recommendations.

Economic development has always been an important task for policy makers. In consideration for Taiwan's economic growth, the goal is to create higher wage job opportunities and raise the general GDP to balance the north-south differences. This is an area where policy can aid the growth by putting resources in the right areas, especially to aid those embryonic clusters in bringing the knowledge based to the speed but with a clear goal set for employment growth. The literature review confirms the need for "bridging policy makers and people" for Taiwan. The policy makers have raised the awareness that they need to be more effective in delivering economic policies. This

triggered the comparative analysis of the economic policy decision models among three continents on top of the data-driven economic landscaping and analyses.

This dissertation research contributes to Taiwan economic development in five ways. The research (1.) compares Taiwan, the US and European's economic policy decision models and displays the differences, (2.) provides a data alignment interface in an international format which regroups existing industrial data labeling into the US and European's cluster standards for future comparative studies, (3.) derives Taiwan's economic landscapes by utilizing the Cluster Mapping analytical framework to analyze industrial dynamics, (4.) analyzes Taiwan's agglomeration models and potentials, and (5.) is written for readers across the board, for practitioners, policy makers, and researchers and to promote cluster initiatives.

Literature indicates the demand for Taiwan's policy makers to be more effective in delivering effective economic policies. Without all the stakeholders' involvements, it would be difficult for policy deliveries to be effective. and government policies with large resources can strengthen the economic development by collaborating with people. Additionally, for the effectiveness of economic policies, the research analyzes the policy makers' decision modes among the US, EU, and Taiwan to address the communication gap issue which was identified by Taiwan's policy makers in the earlier years but unsolved.

The comparative study of policy makers' decision model concludes that Taiwan has a top-down policy model; versus the EUs have a bottom-up initiative model, and the US has an interactive model. We can also imply that the more democratic a place, the more interaction between policy makers and people. Taiwan has a young democracy and is adjusting to the full democratic society. The policy making model still remains the old authoritarian model with top-down economic plans. Recently, Taiwan's citizens are awakening to the transparency of policy decision process and making many demands for change. The Sunflower student movement[44] is one example of the policy transparency demands. It is time for Taiwan's policy makers to evaluate alternatives and to learn from

[44] Ramzy, Austin (22 March 2014). "As Numbers Swell, Students Pledge to Continue Occupying Taiwan's Legislature". New York Times. Retrieved 22 March 2014.

the matured democracies. The authoritarian policy making process eventually will be phased out of a growing democratic and open economy. It is only natural for a full democratic society that people want to make decisions on their own. The recent presidential and legislative election results reflect Taiwan people's demands. Bridging the gap between policy makers and people is an important and urgent task for government to move forward. Taiwan's people can design their own progressive model to solve the gap issue.

Additionally, this is a data-driven research to accurately map industrial data and the location dynamics. Cluster mapping methodology is used to set the framework for data calculations, and growth rates are used to analyze the dynamics. This is also an inductive research from the observations of two rich sets of census data to derive the dynamics of economic development among three different growth rates namely revenue, employment, and wages. Consequently, Taiwan's agglomeration models are derived by analyzing the dynamic relations in reference to the three growth rates. One is the spillovers model, and the other is the supply-chain migration model. One fits domestic agglomeration, and the other fits the external expansion. One has wages rising, and the other does not. Further research can be done to evaluate the supply-chain model for possible wage growing potentials either through skill training or injecting higher knowledge-based innovations to the industry.

In more details, by utilizing cluster framework, a new set of cluster definitions for Taiwan is developed which conforms with the US cluster mapping standards. Taiwan's census's data are used to calculate the dynamics from the past, and analyze the growth factors for any agglomeration effects. The research lands itself on the cluster agglomeration theories. The inductive process is used from observations to concluding the cluster dynamics with three important growth factors and defines their relations. Employment, revenue, and compensation are three important factors for the cluster dynamic research, and even more critically the labor pool is identified as the contextual influence to wage and employment growths. The relation came clear that revenue is the leading factor for the business sustainability which drives the demand for growth, and employment and wages are the dependent factors to gauge the agglomeration effects, and

the supply of labor pool steer the effects between the wage demands and employment supplies.

With the two agglomeration models, the spillovers work for the knowledge-based clusters for the agglomeration of adjacency workforce with domestic expansion that there are prerequisites for the quality of labor. The knowledge required for the industry jobs either takes longer or a certain type of cognition ability. This is different from the supply-chain migration as the flying geese model applies which the external workforce in the foreign locations benefits. The IT cluster dominates the spillover agglomeration model that wage is an important factor. The labor pool condition drives the wage and employment high, when the wages is rising fast, the adjacency locations can benefit from the spillovers. The supply-chain migration model is derived from the characteristic of machine tooling industries which clustered with synchronized growth rates that wage is not the main growing factor. In the case of Production Technology and Analytical Instrument, the wage remains stable among related clusters, but the migration is to another lower labor cost location outside of Taiwan. This model might have contributed to Taiwan's low wage phenomenon that the wage is not rising due to business migrating out of Taiwan or the manpower is replaced by the cheaper migrant workers.

Furthermore, Taiwan is facing the low birthrate problem that Taiwan ranks the least birthrate in the world. The shortage of labor in Taiwan is calling for urgent solutions, and businesses finds ways to expand their income by either moving out or hiring migrant workers. Taiwan's wage ranks very low compared to its neighboring developing economies such as Hong Kong, Korea, China and Singapore. In the meantime, Taiwan is losing its quality manpower to those higher paid economies, and Taiwan will further degrade without the quality workforce and lose competitiveness, and stay behind. Raising the minimum wage and having a tough re-enforcement law is an urgent policy to be called upon. Without raising the wage and competitiveness, Taiwan will further degrade to a low-wage and low-cost economy, and the collected tax will not be sufficient to supply for the public services. The government has already experienced the shortage in budgets for public work, and this is an urgent issue to be addressed.

From the economic landscape, we have learned that Taiwan is rich for its potential from the North to everywhere else. Taiwan has many embryonic industries that are rising and need stimulations and local talents to join the workforce. The supply-chain machine tooling clusters need a full upgrade to be globally competitive. The Business Services industries need the right kind of training for an overall support to Taiwan's international competitions to meet market demands. Policies for education need to be made in accordance to the market demand. Often, businesses are complaining not able to find different kinds of programmers and engineers, and those skills are not taught in Universities because they are too new. College courses needs to be revised and refreshed based on the industrial needs versus all philosophical teachings. More collaborations need to be done between schools and industries.

Surveys tell us that college students are not able to find jobs because their learnings do not match the businesses need. Students need to be introduced to the international events earlier in their life to find out what is new and can be learned. Taiwan's students are too sheltered within an isolated environment until they graduate, and it is too late after the college life when they learned that the world is too far ahead of them. Taiwan used to have five-year college from the junior high school and two-year colleges for vocational training. Those schools have been converted into Universities is a poor policy. There are many students who are not suitable for theoretical trainings should enter the work place for a fast vocational training who can excel in the later part of their life. The middle class workers have been hollowed out by the wrong education policy for the past twenty years. The recourse is needed immediately to adjust to the current market demand for available manpower quality. People should learn their work skills and being able to find work with a good wage. From the EUs and US economic initiative models, both EU and US have job creation in their vision and goals. Taiwan's policy makers need to plan economic policies with the job creation in mind and use it as the outcome measurement. From Taiwan's policies and white papers, this is not a common practice, and the re-enforcement of labor law is too weak; the penalty is too low for those who offend the labor laws.

A case study of Taiwan's biotech industry based on the evaluation of Biopharmaceuticals and Medical Devices clusters gives the suggestion that Taipei region and Tainan region are two different development regions. Taipei, with the wealth of capital resources and many medical research institutes, is best for the pharmaceutical research. Tainan region is best for the Nutraceutical research based on its traditional industrial development of food and machine tooling industries. Bioeconomy is a new field and it is very capital intensive. The industry is still very young. The revenue-compensation ratio shows this weakness. Taiwan overall has another weakness which was documented in the Bioeconomy white paper that Taiwan is weak in marketing in general. The schools teaching remain theoretical and not so practical by my own observation. Taiwanese also are facing English language deficiency. Recently some universities are calling for English taught courses and are facing objections by professors and students. Taiwanese citizens should have the realization that the world is an open one economy instead of many isolated economies, and English is the most spoken business language. Without the proficiency of English communication, Taiwanese are losing their negotiation power.

A case study of Business Services cluster suggested that the cluster's growth rates be active throughout Taiwan but not yet a specialization for many regions. The cluster is in high demand, but wages are declining. The revenue-compensation ratio is much lower than the production industries. Since there is no intensive capital involved, the 3.5 ratios are still reasonable. This is a cluster needs to be fully developed so that it can serve as a supporting industry to all other clusters. Specialties such as business consultants, programmers, engineering consultants, and marketing professionals are all parts of this cluster. The Service Science in Taiwan is a young learning subject. Being the OEM island, this is very diminutive in practice because not so many are in the consumer frontlines to create their products. Often entrepreneurs in Taiwan do not start with the market research unlike the US entrepreneurs[45]. Without good business service training, people can falsely start a project and wastes their efforts at the end. Out of all clusters, this is one cluster stands out from the growth landscape that is telling us to catch up with the growing demands.

[45] Over 90% of my coached students all starts with technologies versus markets.

Taiwan's downstream products are facing severe competition from the lower GDP countries such as China and Southeast Asia. The Downstream Metal Product cluster demonstrates the revenue drop causes a lose in employment, and wages are not rising either. In this case, cost competition is not a long-term strategy. Taiwan needs to find its specializations and diverts the manpower to more specialized or find other operation models such as FloraHolland system solutions to compete. On the other hand, the Transportation and Logistics cluster is facing a wage war with shortage of labor pool. The growth rates on wages and revenue and the sharp declining in employment prove the point. Taiwan can train more manpower based on the market demand to supply domestic and international needs with the rising wage.

The world of digital information users is demanding for an easy access to big data. This research has taken many years to complete from its first question: "How is Taiwan doing while the world suffers from financial crisis?" Now that the crisis is over, and Taiwan survived pretty well compared to some economies with very hard landings. Yet, Taiwan is not without setbacks. Some companies did very well despite the crisis, and some companies closed. Before the technology explosion with information to everyone, people who know more has the upper-hand advantages to make profit simply because other people do not have enough information to compete. Nowadays, the information can be retrieved instantaneously, and has changed the market behavior to demand-driven consumers. Furthermore, knowing where you can have the best access to the available resources is an important factor for competition. But too much information can be troublesome. Organizing just enough information in time is the key to win. This gives the current hot topic for the researchers and engineers to develop data searching, mining, and analysis tools for the latest demands. This research joins that crowd of making information available, in which offers easy interpretation and understanding, and provides for people who can gain the cognition to make the right decisions for their businesses and industries in searching for gaining productivity and competitiveness.

Below is a list of recommendations:

For economic policy makers to deliver effective policies, revising the authoritarian top-down policy model to create initiative directly with practitioners is an urgent task. There

are many ways to do this, the research made two models for suggestions, the bottom-up or interactive. Making the economic policy with job creation as a measurable outcome should be done instead focusing only on technology innovations.

Taiwan's cluster mapping code is translated and internationalized, I recommend this to be taken by the National Statistics Bureau into their daily standards, and further maintain the code and follow up with the internationalization. This can be maintained by a research institute for longitude studies on Taiwan's economic landscape and its dynamism.

For Taiwan's economic development, initiatives can be created for each growing cluster in different regions from bottom-up proposals. Policy makers can review and collaborate with stakeholders to prepare for policy recommended by the initiatives to provide public support to fuel the needed resources for the regional growth. The local government can work on the initiatives forming cluster organizations, so that all in parties public or private are the equal stakeholders for the success and completion goals. The currently public-private structure inhibits the collaboration. The policy makers often behave like a higher-power and control the public resources to the private businesses. Often the public stakeholder is not motivated to be interested in the final outcome since they are not part of the stakeholders.

For the IT industry's spillovers effects, to prepare further education programs for the higher-end knowledge base jobs in the next adjacencies. Currently the spillovers stop at Taichung, and the North and Northeast districts are being saturated. Further southern migrations can be prepared with the education training on vocational basis. Of course, this might be conflicting to the local industries. Setting up incubation centers hosting demanded service training to the IT industries such as engineering training and programming training for the highly demanded manpower, so that the spillovers can cross over Taichung region.

For the supply-demand migration clusters such as Production Technology and Machine Tooling industries, I recommend to setup SME improvement funds to help with the industry upgrades and marketing assistant programs. These industries are short of middle management manpower. The manufactures are mostly outdated and need upgrades either environmentally for automation equipment. The intensive capital required for these

industries is essential. From the economic dynamics that these industries are holding a revenue-compensation ratio around ten which is within a healthy range. It is worth investing into a more competitive business environment. This is where government can involve the private funding with a tax saving incentives to help the industry to grow. The industry is also facing stringent political hardships. There is a need for helping with extra marketing efforts to compensate the national handicap. The point is for the government to be proactive in sending the help to those SMEs. My recommendation is for central and local governments to proactively to find ways to improve business environment, uplift the infrastructure, show their willingness to understand the business difficulties, and solve business problems. This is also calling for the improvement of government services attitude.

Creating business services training programs in vocational courses to elevate the quality of service industries. Taiwanese have an attitude that services should be free. Most people are not willing pay for services with reasonable return. If this mentality is not changed, Taiwan has no chance to internationally brand its industries. Since Business Services cluster is on the rise, the demand is high across the whole economy.

The case study of the Bioeconomy suggests that the Taipei region is better to serve the pharmaceutical market and research. The Tainan region is suggested to serve the Nutraceutical research for both endowments and resources. The surrounding industries such as Hsinchu's IT support for spillovers into the Taipei region. The Taichung's machinery industry's Medical Devices production offers better support for a good outlook of the economic expansion in the Tainan region. Cluster initiatives need to involve both practitioners and policy makers directly and proactively to form organizations for job creation with in mind plan timeframes, so that outcomes can be measured.

Finally, the research does not stop here. The research has created a web platform to display Taiwan's economic landscape and dynamic maps for anyone who is interested in

Taiwan's industrial growth and initiatives.[46] This sets an example as a useful tool to bring together policy makers, practitioners and researchers for their economic planning.

Unfortunately, there is no easy answer of how to make Taiwan's economy sustainable. Policy makers and practitioners need to work proactively together with effective planning tools to make goal oriented initiatives collaboratively as being equal stakeholders to win in the global market. There are models we can learn from. The EU has been using the economic initiative process for decades, and Sweden is a leading country exercising the national competitiveness. Singapore is another country that has successfully adapted to the economic initiative process to prepare for the next lap despite that Singapore is an authoritarian state. Singapore has passed the test through the financial crisis of 2008 doubling its GDP. Taiwan needs to prepare for the realistic economic strategic plan. I highly recommend for policy makers to work with the community proactively forming many goal-oriented initiatives to elevate Taiwan's economic dynamics.

The limitations for this research include (1.) data availability, (2.) industrial demand surveys, and (3.) entrepreneurship of new industries. Firstly, the census data is available only in five-year intervals, and this is a long timeframe. Other shorter data intervals can be used to overcome the data limitations. It takes much more data verification and normalization effort be accurate. Secondly, the current dissertation web portal still is in its inception stage. More can be done to interact with the users including collecting additional surveys and feedback. Both the EU Observatory and the US Cluster Mapping portals have been collecting ongoing data on industrial demands and feedback. Taiwan's portal can be designed to have users' interaction on current demands. Thirdly, the growth methodologies work better to measure the agglomerated industries. The newer industries and entrepreneurship are less predictable in this framework; therefore, maybe overlooked.

On the other hand, the new industries would have more chance for success with supporting industries that are successful. The expandability can come from the traditional and successful industries. Therefore, more research can be done to study the inter-connection of various industrial supports from the matured industries. Cross-linkage of

[46] Taiwan's economic landscape can be found on http://tisc.nccu.edu.tw/bubble

industries is an interesting subject to be researched. Many traditional industries are short of information as they are not utilizing the newly developed technologies. Integrating the new technologies with the old industries could bring many new possibilities to the existing industries. Nevertheless, the local specialties provide the backdrop for the community uniqueness, and they are important for the social expansion into the future industrial sustainability. Finally, technologies are designed to serve people. This is the beginning of new social transformation through technology innovations. Bridging the old and new into the newly integrated lifestyle will be the future.

There is much more to be done after this research. At the end of 2016, another release of the Taiwan Census data will be available. Forthcoming, I will take the data to be converted, normalized, and mapped to display the latest economic landscape and shared to the public. Further annual research will update dynamic economic landscape visualizations to reflect the immediate timeframe. The EU has already developed initiatives by cluster organizations to make economic development more manageable. Taiwan is pioneering these developments in Asia. Porter favors of methodological framework that is useful and not just theory. I concur.

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Appendix 1. - Research Background

I started the research with the following questions, “Is Cluster Mapping framework the right methodology to use for this research?” In other words, is the methodology suitable for Taiwan? For this research, I had the same doubt in 2013 when I first found the theory after I reviewed all Schumpeter’s works in 2011 at Berkeley, and continue to research the dynamics of competition. I further researched Clayton Christensen’s disruptive innovation (Christensen, 1997) in which innovation was used as a strategy to be competitive. Further reading brought me to Porter’s strategy and competition. Until I reached the article describing the mechanics of Cluster Mapping and its progress (Ketels, 2011) that there is more than 1400 initiatives on cluster research in 2005. Furthermore, his research indicates that European Commission in 2007 indicated that all EU member countries have some types of cluster-policy program in place. Just by the numbers, I realize that despite the theory is not perfect, it is a useful framework. Porter’s cluster theory was not an accident. It was requested by the customer’s demand, President Ronald Reagan’s Commission asked him in 1985 to research on the US competitiveness. He surveyed the business environment and derived the cluster idea. Such inductive research method is as normal as it can be, and Porter persists on despite all the criticisms in the earlier years.

After reading the articles and learning the origin of the theoretical framework, its development path, testing period, and the success being used by policy makers, and the projection of the future direction. At the time the US Cluster Mapping was still in program and not yet fully released to the public, and I had a preview of the mapping system. I researched that Taiwan wass lacking a system to provide a simple overview of Taiwan’s industries. I decided to give Professor Porter a call to meet him in person. My goal was to find out in an interview that the practical part of the methodology, and how to operationalize the framework, so that I could build one too for Taiwan. I met Professor Porter in October 17, 2013 as my investigation went on. Porter at the first meeting gave me the commitment to help me to construct Taiwan’s Cluster Mapping. I still need to investigate the operational side of this research, so I helped my school to join the Institutes for Strategy and Competitiveness (ISC), an organization created by Porter to

promote his theoretical work. The goal is to find out, 1. How do I operationalize the methodology? 2. Finish my dissertation; 3. Learn to teach the framework to other researchers.

Since then, I have participated three times of ISC annual conferences and networked with over one hundred other faculties from all over the world on research collaboration. Everyone in the working group was researching some topics around the clusters. The dynamics and synergy was great there. As matter of fact, that is how you really want to start an initiative. It is not the theory, but people who makes things happen. We witness tighter many research reports and theoretical discoveries about cluster's topic. The Europeans are currently researching on cluster organizations. The US is starting the national interactive initiatives, and Asian is just starting their learning about the cluster mapping framework. The international network is very active in the research group. EU continues to provide funding for a more complete EU version of clusters initiatives. Over the years, EU has more than thousands of the Clusters Initiatives being proposed and granted. In 2014 annual conference, an Asian Chapter of ISC was established.

Many countries from Asia such as India, Japan, Korea, Thailand, Indonesia, Malaysia, Miramar, and Taiwan all participated with enthusiasm, and we are here to collaborate and to make contributions to the cluster society hoping to bring contributions to our own countries. The synergy among all countries is high. Now that with Porter's leadership, the cluster field will continue to build wider and deeper and spillover into many fields which was criticized being too broad and lack of contents before, but now is flourishing by many other practitioners, policy makers, and researchers. The contents over the years are being built with case studies and theoretical constructs. Taiwan shall not and cannot be absent from this international networking opportunity.

The most recent breakthrough research by Delgado, Porter, and Stern's (Delgado, Porter, et al., 2015) research findings, clusters are being re-defined with a broader comparative study with inter-industry linkages identified. US cluster mapping research was triggered by the world financial crisis in 2008 to identify solutions for to revitalize the US economy which was funded by the EDA of the US Commerce Department, and the US Cluster Mapping platform was formally released in September 2014 (EDA, 2014). The

new Clusters are defined with important added linkage relations based on the co-location theory (Malmberg & Maskell, 2002; Maskell, 2001; Reichhart & Holweg, 2008). The definition is further being refined with clear measurable factors. Clusters are geographic concentrations of industries related to knowledge, skills, inputs, demand, and/or other linkages (Delgado et al., 2014). The new method remaps the old industrial clusters into a broader collocated cluster with theories of productivity factors including employment, wage, and innovation. Taiwan has the most active Original Equipment Manufacturing (OEM) clusters in the IT (Information Technology) industry, and the success has been built on co-location factors. For example, when Foxconn migrates to another country for reproduction, all upstream suppliers migrate with the giant to tighten the co-location effect.

Porter expressed in his speech stressing price-cut, weak currency, and job per se is not a competitive strategy. The competitiveness is built on long-run productivity and efficiency of a location, business agglomeration and employments with innovations. (Porter, 2014) (Porter, 2014) The long-run productivity means the productivity of existing firms and workers, and the ability to achieve high participation of citizens in the workplace. In layman's term, many people in the same area are motivated to work for companies which rewards them for their quality work. The recent research release has continued to conclude factors, such as employment, wages, and innovations are important factors to be measured, and thus the cluster linkage methodology is built upon those important factors (Delgado, Porter, et al., 2015). Furthermore, wage growth is identified as the most important factor to represent the rising of productivity and efficiency in relations to its employment growth. The business agglomeration factor can be measured by the revenue in relations to employment and wage growths. Innovation is an important factor to trigger the competition pace for the efficiency and productivity measurement. Innovation may not be the most critical factor, but it serves a great stimulus to the productivity growth. In this research, relations among all growth rates will be identified and used for evaluation.

Appendix 2. - Data Preparation

The following steps are taken to prepare the data for analysis.

1. Define Taiwan's cluster code (See Appendix - The US Clusters Code) – Taiwan Clusters Code basically follows the US Cluster Code definitions. In order to confirm that all cluster codes match closely with the US cluster, stepping through each code and evaluate the match is necessary. This has been done with the collaboration of the US Cluster Code manager, Richard Bryden in February 2015. A matching process evaluating through each code and confirming the best match for the code was carefully done. Over ninety percent of the codes are the exact match even with the names. Some categories do not apply, and there are six clusters not being used. Agriculture, mining, forestry, government, and primary education data are not included in the Industry and Commerce data; therefore, all six clusters are presented in number 0. These empty clusters are: Agriculture (code:2), Coal Mining (code:7), Electric Power Generation (code:14), Forestry (code:20), Local Education (code:113), and Tobacco (code:43). Taiwan has stopped Tobacco production during this period. Total 61 clusters are being actively evaluated, and there are 46 traded clusters, and 15 local clusters remaining.
2. Processing through the Taiwan Census Data sets took time and effort. For the privacy reason, parts of data are not displayed but was replaced with a mark (D) by the National Statistics Bureau. Any industry with enterprises less than 3 is blocked by another selected larger group, so that privacy can be protected to the obvious enterprises. A reversal calculation was done at the first data estimation path that averaging method is used to estimate the data. Once the first path is done, the researcher can request entering the National Statistics Bureau to use the real uncovered data to calculate the true ratio. Researcher can take the ratio calculation out without taking out the original data sets. This cost more time for the data processing. The simulation of reversal calculation was done at first to create a model for the cluster data. Once the model is verified, it can be used for other sets of Census data. Currently, there are two sets of Census data, 2006 and 2011 used for this research. The earlier census data will require more work to transform from the old format into the newest cluster coded format. Some earlier data are even on paper print which is very cumbersome to use. Fortunately, for the

proof of concept, the two sets of data are provided, which are good to model the process for the future data processing.

3. Six data categories were extracted from these two sets of data, and they are enterprise establishments, employment counts, revenue, labor compensation, expenditure, and operating revenue. Data sum is checked against each step of the process, so that the data quality is kept and balance sum always checked against the original data to ensure the data is error free.
4. Create a cluster map on every City and for every cluster - Since the original data were collected on the City base. The smallest region is defined to be on City level. A matrix of 135 by 45 data maps is created for one set of census raw data. This is the actual collected enterprise data, thus, will provide close to accurate estimates.
5. Calculate the shares – The units of data categories are "counts" for establishment, "counts" for employment, "NT$ unit in1,000" for revenue, labor compensation, expenditure, and operating revenue. The first step is to calculate the shares of each cluster for each City. We will be able to see the differences of all the clusters in their shares. Some are predominately large, and some are very small (See Figure 47 Taiwan's Cluster Composition). Also calculate the total Traded and Local cluster shares, and they are 63:37 ratios. This means there are 63% of employment in Traded clusters, and 37% of employment in Local clusters. The US has 40:60 ratios, just the opposite of Taiwan. The US has more employment in the Local clusters. Their Business Services is more developed according to Ketels[47]. Taiwan is a small economy depends on export surplus, therefore, the Traded clusters carry more weight.
6. Calculate the growth rates - Between 2006 and 2011, there are 5 years of compounded annual growth rate (CAGR) to be calculated. Employment growth rates, revenue growth rates, and wage growth rates among all clusters in all regions (National, City, District) are calculated.
7. Plot graphs - The most meaningful graph is the 3-dimentional bubble plots to show the dynamics of each growths. A wage graph uses average wage on x-axis,

[47] In the clusters ratio discussion on 3/2/2016

employment shares on y-axis, and employment size for bubble sizes to indicate cluster growths and declines. The bubble chart is very easy to identify the dynamics with the alignment of cluster sizes especially plotting the growth rates. The three dimensional charts provide dynamic information well; therefore, it is used throughout this report.

8. Run statistic correlation. Despite the Taiwan cluster definitions is adapted from the US cluster definitions. A statistics correlation is run to see their relations. A correlation of all three growth rates are run to show that the traded clusters are highly correlated clusters, and the local cluster is not. This confirms Porter's claims on Traded Cluster's importance. (See Appendix IV Pearson's Correlation on Traded Clusters' Growth Rates and Appendix V Pearson's Correlation on Local Clusters' Growth Rates)
9. Calculate Location Quotients for each cluster of each city. This gives the indication of regional concentration of a cluster. The higher the concentration, the more important is the cluster to the nation for the cluster. Location Quotient represents the concentration of a cluster which is also a specialization indicator. LQ equals 1 meaning the cluster has the same concentration as the Taiwan's total ratio. LQ and shares can be interpreted differently, LQ means more to a region because if LQ is very high it means the city specializes the cluster may have some special knowledge to offer. This shares means more to a nation since the large the shares mean the more employment impacts. Population sizes matters too, if a larger region has a specialization that is highly populated, this cluster may have spillover effects when the cluster saturates. IT in Hsinchu is an example of this (Figure 98).
10. Draw maps of cities individually to see the clustered industries and its growth rate and employment shares. This provides a clear picture how dynamic is the cluster activities and labor movements. (See Figure 86 to Figure 142)

Appendix 3. - The US Clusters Code Definitions

Cluster code	Cluster name	Sub code	Sub name
1	Aerospace Vehicles and Defense	1	Aircraft
1	Aerospace Vehicles and Defense	2	Missiles and Space Vehicles
1	Aerospace Vehicles and Defense	3	Search and Navigation Equipment
2	Agricultural Inputs and Services	1	Agricultural Services
2	Agricultural Inputs and Services	2	Farm Management and Labor Services
2	Agricultural Inputs and Services	3	Fertilizers
3	Apparel	1	Accessories and Specialty Apparel
3	Apparel	2	Men's Clothing
3	Apparel	3	Women's Clothing
3	Apparel	4	Apparel Contractors
4	Automotive	1	Automotive Parts
4	Automotive	2	Gasoline Engines and Engine Parts
4	Automotive	3	Motor Vehicles
4	Automotive	4	Small Vehicles
4	Automotive	5	Military Vehicles and Tanks
4	Automotive	6	Metal Mills and Foundries
5	Biopharmaceuticals	1	Biopharmaceutical Products
5	Biopharmaceuticals	2	Biological Products
5	Biopharmaceuticals	3	Diagnostic Substances
6	Business Services	1	Corporate Headquarters
6	Business Services	2	Consulting Services
6	Business Services	3	Business Support Services
6	Business Services	4	Computer Services
6	Business Services	5	Employment Placement Services
6	Business Services	6	Engineering Services
6	Business Services	7	Architectural and Drafting Services
6	Business Services	8	Ground Passenger Transportation
7	Coal Mining	1	Coal Mining
8	Communications Equipment and Services	1	Communications Services
8	Communications Equipment and Services	2	Communications Equipment
8	Communications Equipment and Services	3	Communications Equipment Components
9	Construction Products and Services	1	Construction
9	Construction Products and Services	2	Water, Sewage, and Other Systems
9	Construction Products and Services	3	Construction Products
9	Construction Products and Services	4	Construction Components
9	Construction Products and Services	5	Construction Materials
10	Distribution and Electronic Commerce	1	Warehousing and Storage
10	Distribution and Electronic Commerce	2	Electronic and Catalog Shopping

10	Distribution and Electronic Commerce	3	Wholesale Trade Agents and Brokers
10	Distribution and Electronic Commerce	4	Support Services
10	Distribution and Electronic Commerce	5	Wholesale of Apparel and Accessories
10	Distribution and Electronic Commerce	6	Wholesale of Books, Periodicals, and Newspapers
10	Distribution and Electronic Commerce	7	Wholesale of Chemical and Allied Products
10	Distribution and Electronic Commerce	8	Wholesale of Drugs and Druggists' Sundries
10	Distribution and Electronic Commerce	9	Wholesale of Farm Products and Supplies
10	Distribution and Electronic Commerce	10	Wholesale of Food Products
10	Distribution and Electronic Commerce	11	Wholesale of Furniture and Home Furnishing
10	Distribution and Electronic Commerce	12	Wholesale of Jewelry, Watches, Precious Stones, and Precious Metals
10	Distribution and Electronic Commerce	13	Wholesale of Paper and Paper Products
10	Distribution and Electronic Commerce	14	Wholesale of Sporting and Recreational Goods and Supplies
10	Distribution and Electronic Commerce	15	Wholesale of Toy and Hobby Goods and Supplies
10	Distribution and Electronic Commerce	16	Wholesale of Other Merchandise
10	Distribution and Electronic Commerce	17	Wholesale of Farm and Garden Machinery and Equipment
10	Distribution and Electronic Commerce	18	Wholesale of Construction and Mining Machinery and Equipment
10	Distribution and Electronic Commerce	19	Wholesale of Industrial Machinery, Equipment, and Supplies
10	Distribution and Electronic Commerce	20	Wholesale of Service Establishment Equipment, and Supplies
10	Distribution and Electronic Commerce	21	Wholesale of Transportation Equipment and Supplies (except Motor Vehicles)
10	Distribution and Electronic Commerce	22	Wholesale of Professional and Commercial Equipment and Supplies
10	Distribution and Electronic Commerce	23	Wholesale of Electrical and Electronic Goods
10	Distribution and Electronic Commerce	24	Wholesale of Metals and Minerals (except Petroleum)
10	Distribution and Electronic Commerce	25	Wholesale of Petroleum and Petroleum Products
10	Distribution and Electronic Commerce	26	Rental and Leasing
11	Downstream Chemical Products	1	Personal Care and Cleaning Products
11	Downstream Chemical Products	2	Processed Chemical Products
11	Downstream Chemical Products	3	Dyes, Pigments and Coating
11	Downstream Chemical Products	4	Explosives
11	Downstream Chemical Products	5	Lubricating Oils and Greases
12	Downstream Metal Products	1	Metal Products
12	Downstream Metal Products	2	Ammunition
12	Downstream Metal Products	3	Fabricated Metal Structures
12	Downstream Metal Products	4	Metal Containers
13	Education and Knowledge Creation	1	Training Programs
13	Education and Knowledge Creation	2	Colleges, Universities, and Professional Schools
13	Education and Knowledge Creation	3	Educational Support Services

13	Education and Knowledge Creation	4	Research Organizations
13	Education and Knowledge Creation	5	Professional Organizations
14	Electric Power Generation and Transmission	1	Fossil Fuel Electric Power
14	Electric Power Generation and Transmission	2	Alternative Electric Power
14	Electric Power Generation and Transmission	3	Electric Power Transmission
15	Environmental Services	1	Waste Collection
15	Environmental Services	2	Waste Processing
15	Environmental Services	3	Other Waste Management Services
16	Financial Services	1	Financial Investment Activities
16	Financial Services	2	Credit Intermediation
16	Financial Services	3	Credit Bureaus
16	Financial Services	4	Monetary Authorities - Central Bank
16	Financial Services	5	Securities Brokers, Dealers, and Exchanges
17	Fishing and Fishing Products	1	Fishing and Fishing Products
18	Food Processing and Manufacturing	1	Specialty Foods and Ingredients
18	Food Processing and Manufacturing	2	Baked Goods
18	Food Processing and Manufacturing	3	Candy and Chocolate
18	Food Processing and Manufacturing	4	Coffee and Tea
18	Food Processing and Manufacturing	5	Packaged Fruit and Vegetables
18	Food Processing and Manufacturing	6	Dairy Products
18	Food Processing and Manufacturing	7	Animal Foods
18	Food Processing and Manufacturing	8	Soft Drinks and Ice
18	Food Processing and Manufacturing	9	Malt Beverages
18	Food Processing and Manufacturing	10	Distilleries
18	Food Processing and Manufacturing	11	Wineries
18	Food Processing and Manufacturing	12	Milling and Refining of Cereals and Oilseeds
18	Food Processing and Manufacturing	13	Milling and Refining of Sugar
18	Food Processing and Manufacturing	14	Farm Wholesalers
18	Food Processing and Manufacturing	15	Glass Containers
19	Footwear	1	Footwear
19	Footwear	2	Footwear Components
20	Forestry	1	Forestry
21	Furniture	1	Household Furniture
21	Furniture	2	Institutional Furniture
21	Furniture	3	Office Furniture
21	Furniture	4	Wood Cabinets and Woodwork
21	Furniture	5	Mobile Homes
22	Hospitality and Tourism	1	Spectator Sports
22	Hospitality and Tourism	2	Amusement Parks and Arcades
22	Hospitality and Tourism	3	Cultural and Educational Entertainment
22	Hospitality and Tourism	4	Gambling Facilities
22	Hospitality and Tourism	5	Other Tourism Attractions

22	Hospitality and Tourism	6	Accommodations and Related Services
22	Hospitality and Tourism	7	Tourism Related Services
23	Information Technology and Analytical Instruments	1	Electronic Components
23	Information Technology and Analytical Instruments	2	Computers and Peripherals
23	Information Technology and Analytical Instruments	3	Semiconductors
23	Information Technology and Analytical Instruments	4	Software Publishers
23	Information Technology and Analytical Instruments	5	Software Reproducing
23	Information Technology and Analytical Instruments	6	Process and Laboratory Instruments
23	Information Technology and Analytical Instruments	7	Medical Apparatus
23	Information Technology and Analytical Instruments	8	Audio and Video Equipment
24	Insurance Services	1	Insurance Related Services
24	Insurance Services	2	Insurance Carriers
24	Insurance Services	3	Reinsurance Carriers
25	Jewelry and Precious Metals	1	Jewelry and Precious Metals Products
26	Leather and Related Products	1	Personal Leather Goods and Luggage
26	Leather and Related Products	2	Women's Handbags and Purses
26	Leather and Related Products	3	Textile Bags and Canvas Products
27	Lighting and Electrical Equipment	1	Lighting Fixtures and Parts
27	Lighting and Electrical Equipment	2	Electrical Equipment
27	Lighting and Electrical Equipment	3	Electrical Components
27	Lighting and Electrical Equipment	4	Storage Batteries
28	Livestock Processing	1	Meat Processing
28	Livestock Processing	2	Livestock Merchant Wholesalers
29	Marketing, Design, and Publishing	1	Advertising Related Services
29	Marketing, Design, and Publishing	2	Other Marketing Related Services
29	Marketing, Design, and Publishing	3	Design Services
29	Marketing, Design, and Publishing	4	Publishing
30	Medical Devices	1	Optical Instruments and Ophthalmic Goods
30	Medical Devices	2	Surgical and Dental Instruments and Supplies
31	Metal Mining	1	Metal Mining
32	Metalworking Technology	1	Metalworking Machinery
32	Metalworking Technology	2	Machine Tools and Accessories
32	Metalworking Technology	3	Hand Tools
32	Metalworking Technology	4	Fasteners
32	Metalworking Technology	5	Metal Processing
33	Music and Sound Recording	1	Music and Sound Recording
34	Nonmetal Mining	1	Nonmetal Mining
35	Oil and Gas Production and Transportation	1	Petroleum Processing
35	Oil and Gas Production and Transportation	2	Support Activities for Oil and Gas Operations
35	Oil and Gas Production and Transportation	3	Drilling Wells

35	Oil and Gas Production and Transportation	4	Oil and Gas Extraction
35	Oil and Gas Production and Transportation	5	Oil and Gas Machinery
35	Oil and Gas Production and Transportation	6	Pipeline Transportation
36	Paper and Packaging	1	Paper Mills
36	Paper and Packaging	2	Packaging
36	Paper and Packaging	3	Paper Products
37	Performing Arts	1	Performing Artists
37	Performing Arts	2	Promoters and Managers
38	Plastics	1	Plastic Products
38	Plastics	2	Plastic Materials and Resins
39	Printing Services	1	Printing Inputs
39	Printing Services	2	Support Activities for Printing
39	Printing Services	3	Printing Services
39	Printing Services	4	Greeting Card Printing and Publishing
40	Production Technology and Heavy Machinery	1	Industrial Machinery
40	Production Technology and Heavy Machinery	2	Agricultural and Construction Machinery and Components
40	Production Technology and Heavy Machinery	3	Air Handling Equipment
40	Production Technology and Heavy Machinery	4	Commercial and Service Industry Machinery
40	Production Technology and Heavy Machinery	5	Moving and Material Handling Equipment
40	Production Technology and Heavy Machinery	6	Process Equipment and Components
41	Recreational and Small Electric Goods	1	Recreational and Decorative Goods
41	Recreational and Small Electric Goods	2	Games, Toys, and Children's Vehicles
41	Recreational and Small Electric Goods	3	Motorcycles and Bicycles
41	Recreational and Small Electric Goods	4	Sporting and Athletic Goods
41	Recreational and Small Electric Goods	5	Office Supplies
41	Recreational and Small Electric Goods	6	Electric Housewares
42	Textile Manufacturing	1	Yarn and Thread Mills
42	Textile Manufacturing	2	Fabric Mills
42	Textile Manufacturing	3	Textile and Fabric Finishing
42	Textile Manufacturing	4	Knitting Mills
42	Textile Manufacturing	5	Household Textile Products
42	Textile Manufacturing	6	Other Textile Products
42	Textile Manufacturing	7	Fibers
43	Tobacco	1	Tobacco
44	Trailers, Motor Homes, and Appliances	1	Trailers and Motor Homes
44	Trailers, Motor Homes, and Appliances	2	Burial Caskets
44	Trailers, Motor Homes, and Appliances	3	Household Appliances
45	Transportation and Logistics	1	Air Transportation

45	Transportation and Logistics	2	Specialty Air Transportation
45	Transportation and Logistics	3	Ground Transportation Support Activities
45	Transportation and Logistics	4	Trucking
45	Transportation and Logistics	5	Bus Transportation
46	Upstream Chemical Products	1	Organic Chemicals
46	Upstream Chemical Products	2	Inorganic Chemicals
46	Upstream Chemical Products	3	Industrial Gas
46	Upstream Chemical Products	4	Agricultural Chemicals
47	Upstream Metal Manufacturing	1	Iron and Steel Mills and Forging
47	Upstream Metal Manufacturing	2	Metal Processing
47	Upstream Metal Manufacturing	3	Metal Products
47	Upstream Metal Manufacturing	4	Wires and Springs
48	Video Production and Distribution	1	Video Production and Distribution
49	Vulcanized and Fired Materials	1	Clay Products and Refractories
49	Vulcanized and Fired Materials	2	Glass Products
49	Vulcanized and Fired Materials	3	Rubber Products
50	Water Transportation	1	Water Passenger Transportation
50	Water Transportation	2	Marine Transportation Services
50	Water Transportation	3	Boat Building and Repairing
51	Wood Products	1	Wood Processing
51	Wood Products	2	Wood Components and Products
51	Wood Products	3	Prefabricated Wood Building
101	Local Food and Beverage Processing and Distribution	1	Food Wholesaling
101	Local Food and Beverage Processing and Distribution	2	Commercial and Retail Bakeries
101	Local Food and Beverage Processing and Distribution	3	Retail Food Stores
101	Local Food and Beverage Processing and Distribution	4	Tobacco Retailing
101	Local Food and Beverage Processing and Distribution	5	Beer and Liquor Wholesaling
101	Local Food and Beverage Processing and Distribution	6	Beer, Wine, and Liquor Retailing
101	Local Food and Beverage Processing and Distribution	7	Vending and Direct Selling
102	Local Personal Services (Non-Medical)	1	Cleaning Services
102	Local Personal Services (Non-Medical)	2	Hair Care Services
102	Local Personal Services (Non-Medical)	3	Photographic and Photofinishing Services
102	Local Personal Services (Non-Medical)	4	Repair Services
102	Local Personal Services (Non-Medical)	5	Child Care Services
102	Local Personal Services (Non-Medical)	6	Other Personal Services
102	Local Personal Services (Non-Medical)	7	Personal Products Retailing
103	Local Health Services	1	Healthcare Provider Offices
103	Local Health Services	2	Hospitals
103	Local Health Services	3	Medical Laboratories

103	Local Health Services	4	Home and Residential Care
103	Local Health Services	5	Funeral Service and Crematories
103	Local Health Services	6	Medical Equipment Distribution and Rental
103	Local Health Services	7	Drug Stores
103	Local Health Services	8	Optical Goods Retailing
104	Local Utilities	1	Communications Services
104	Local Utilities	2	Utility distribution
104	Local Utilities	3	Natural Gas Distribution
104	Local Utilities	4	Heating Oil and Other Fuel Dealers
104	Local Utilities	5	Sanitary Services
105	Local Logistical Services	1	Local Passenger Transportation
105	Local Logistical Services	2	Local Transportation Services
105	Local Logistical Services	3	Warehousing Services
105	Local Logistical Services	4	Truck Leasing
105	Local Logistical Services	5	Passenger Car Rental
106	Local Household Goods and Services	1	Landscape and Horticultural Services
106	Local Household Goods and Services	2	Electronics Repair
106	Local Household Goods and Services	3	Appliance Retailing
106	Local Household Goods and Services	4	Hardware Wholesaling
106	Local Household Goods and Services	5	Hardware Retailing
106	Local Household Goods and Services	6	Gardening Products and Supplies Retailing
106	Local Household Goods and Services	7	Furniture and Homefurnishings Retailing
107	Local Financial Services	1	Deposit-taking Institutions
107	Local Financial Services	2	Pension, Health, and Welfare Funds
107	Local Financial Services	3	Insurance Agents and Brokers
107	Local Financial Services	4	Tax Return Preparation Services
107	Local Financial Services	5	Collection Agencies
108	Local Motor Vehicle Products and Services	1	Automotive Wholesaling
108	Local Motor Vehicle Products and Services	2	Automobile Dealers
108	Local Motor Vehicle Products and Services	3	Other Motor Vehicles Distribution
108	Local Motor Vehicle Products and Services	4	Automotive Repair Shops
108	Local Motor Vehicle Products and Services	5	Gasoline Stations
108	Local Motor Vehicle Products and Services	6	Parking Services
108	Local Motor Vehicle Products and Services	7	Other Automotive Services
108	Local Motor Vehicle Products and Services	8	Automotive Parts Wholesaling
108	Local Motor Vehicle Products and Services	9	Automotive Parts Retailing
109	Local Retailing of Clothing and General Merchandise	1	Apparel Retailing
109	Local Retailing of Clothing and General Merchandise	2	Jewelry Retailing
109	Local Retailing of Clothing and General Merchandise	3	General Merchandise Retailing

109	Local Retailing of Clothing and General Merchandise	4	Sewing, Needlework, and Piece Goods Retailing
109	Local Retailing of Clothing and General Merchandise	5	Luggage Retailing
110	Local Entertainment and Media	1	Newspapers
110	Local Entertainment and Media	2	Electronic Media
110	Local Entertainment and Media	3	Movie Theatres
110	Local Entertainment and Media	4	Book and Periodical Retailing
110	Local Entertainment and Media	5	Musical Instruments Retailing
110	Local Entertainment and Media	6	Sporting and Hobby Retailing
110	Local Entertainment and Media	7	Video Rental
110	Local Entertainment and Media	8	Electronic and Photographic Retailing
111	Local Hospitality Establishments	1	Hospitality Establishments
111	Local Hospitality Establishments	2	Recreational Facilities and Instruction
111	Local Hospitality Establishments	3	Gifts and Souvenirs Retailing
112	Local Commercial Services	1	Local Professional Services
112	Local Commercial Services	2	Commercial Photography, Printing and Signmaking
112	Local Commercial Services	3	Laundry and Linen Services
112	Local Commercial Services	4	Building Support Services
112	Local Commercial Services	5	Miscellaneous Repair Services
112	Local Commercial Services	6	Security Services
112	Local Commercial Services	7	Testing Laboratories
112	Local Commercial Services	8	Stationery and Office Supply Retailing
113	Local Education and Training	1	Elementary and Secondary Schools
113	Local Education and Training	2	Job Training Services
113	Local Education and Training	3	Recreational and Other Services
114	Local Community and Civic Organizations	1	Trusts
114	Local Community and Civic Organizations	2	Social Service Organizations
114	Local Community and Civic Organizations	3	Business Associations
114	Local Community and Civic Organizations	4	Labor Organizations
114	Local Community and Civic Organizations	5	Political Organizations
114	Local Community and Civic Organizations	6	Religious Organizations
115	Local Real Estate, Construction, and Development	1	Real Estate Services
115	Local Real Estate, Construction, and Development	2	General Contractors
115	Local Real Estate, Construction, and Development	3	Developers
115	Local Real Estate, Construction, and Development	4	Specialty Contractors
115	Local Real Estate, Construction, and Development	5	Highway and Street Construction
115	Local Real Estate, Construction, and Development	6	Water and Sewer Line Construction
115	Local Real Estate, Construction, and Development	7	Concrete Products
115	Local Real Estate, Construction, and Development	8	Construction Materials Wholesaling

115	Local Real Estate, Construction, and Development	9	Construction Materials Retailing
115	Local Real Estate, Construction, and Development	10	Building Equipment Distribution
116	Local Industrial Products and Services	1	Industrial Repair Services
116	Local Industrial Products and Services	2	Industrial Products and Services Wholesaling
116	Local Industrial Products and Services	3	Industrial Machinery and Distribution
116	Local Industrial Products and Services	4	Miscellaneous Equipment Rental and Leasing

Source: US Cluster Mapping

Appendix 4. - Taiwan Clusters Code Definitions

See Taiwan Cluster Code Definitions Excel file.

Appendix 5. - Taiwan's Population Density

City	Population
New Taipei City	3,916,451
Taipei City	2,650,968
Taichung City	2,664,394
Tainan City	1,876,960
Kaohsiung City	2,774,470
Yilan County	459,061
Taoyuan County	2,013,305
Hsinchu County	517,641
Miaoli County	562,010
Changhua County	1,303,039
Nantou County	522,807
Yunlin County	713,556
Chiayi County	537,942
Pingtung County	864,529
Taitung County	228,290
Hualien County	336,838
Penghu County	97,157
Keelung City	379,927
Hsinchu City	420,052
Chiayi City	271,526
Kinmen County	103,883
Lienchiang County	10,106

Appendix 6. - Propositions and Variable Relations

Follow the inductive research method, propositions and variables are derived and explained below. Employment gain is driven by the business gain and labor supply. This means when business is on the rise, wage may be fluctuated by labor supply efficiency either skills or saturation. If the business is down, employment can be affected directly in that cluster.

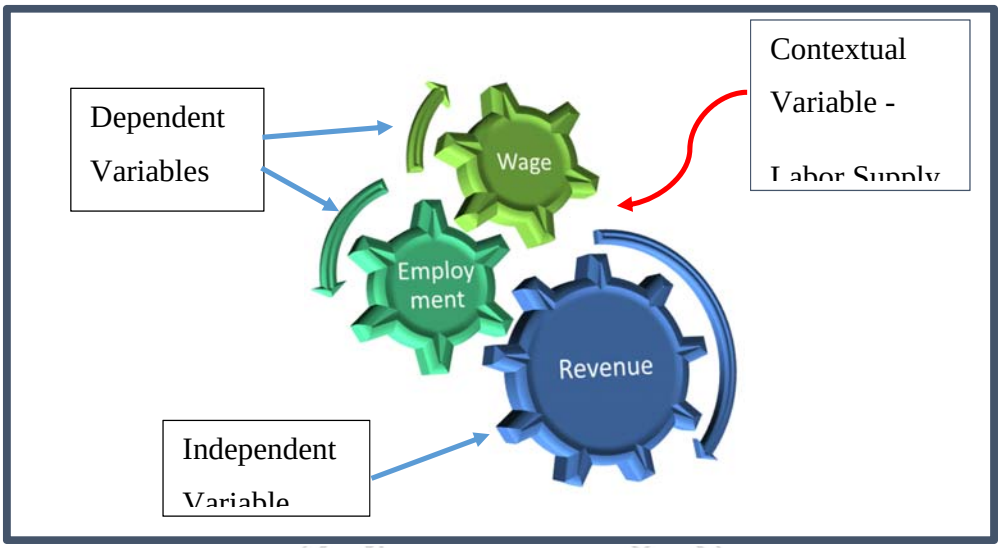
Below four propositions induced from the observation of Figure 156 sets the foundations for the context evaluation for later cluster analyses:

1. Employment can gain when business revenue grows provided there is no shortage of labor supply. If labor is in shortage, wage can rise. (Right Upper Quadrant)
2. It is rare that employment gains when revenue is declining. (Right Lower Quadrant)
3. Employment growth is independent of Wage rise or fall. Employment growth is in contextual of labor supply. (Left Upper and Lower Quadrants) Employment drops when labor pool is in shortage.
4. Wage growth is reversely related to employment growth in the context of labor supply. Wage grows when there is undersupply of manpower, and wages drops when there is oversupply of manpower. Causes for shortages can be lack of participants, lack of qualified skills, or isolation[48].

From the synopsis which defines the variable relationships, revenue is an independent variable; employment, wage are dependent variables, and the labor supply in this case is a contextual variable. See Figure 85 below.

[48] Government survey on labor participation. Industry owners cannot find qualified workers. One industry owner explains that they moved to a more rural area for a bigger factory site but far away from the skilled master, in which the isolation cause them not being able to secure masters for their handwork in a machine tool industry.

Figure 85 Cluster Agglomeration Growth Variable Relations



Within the framework of classical economic theory, Taiwan, an open economy with limited supply of labor and a weak labor law re-enforcement that manpower supply[49] can trigger wages to rise or fall (Lewis, 1954), In this analysis, business revenue and manpower are two major drivers for the employment and wage rise. In Figure 156, the winners are in the upper right quadrant from the center (0,0). One important thing to notice is that when there is an employment gain, there is always a revenue gain, and this proves Proposition 1. [Employment can gain when business revenue gains provided there is no shortage of manpower supply.] When revenue is at a loss, employment can decline (lower left quadrant). On the other hand, the lower right quadrant with no clusters implies employment will not likely to grow when loss of revenue, and this proves the Proposition 2. [It is rare that employment gain when business revenue is declining.] Furthermore, if businesses loss orders, it can affect employment to go down when the supply of work reduces. We also see that employment can gain when wages are up and revenues down. That can be a condition when the work requires special conditions such as specially trained skills, or undersupply of manpower (with the contextual variable – labor supply).

[49] Taiwan lowest birthrate and very stringent immigration policy all contribute to the limited manpower supply pool, and Taiwan fits in the profile of scares of capital and resources.

From the same Employment Gain Figure, it indicates that Metal working Technology is gaining revenue, but the wage is dropping with the employment gain. Similarly, there can also be case of declining wages with revenue gain of oversupply of manpower in the right lower quadrant (Proposition 3). Proposition 4: [Wage growth is reversely related to the employment growth in the context of labor supply.] that the wage can go up if there is a shortage of labor supply despite the business and employment are both done.

The losers are on the lower left quadrant with all rates declined. The worse situation is revenue declines which drives everything down due to the lack of business demand. In this case, the worst clusters are the Leather and Related Products, Metal Mining Jewelry and Precious Metals, Music and Sound Recording, and Local Household Goods and Services for Taiwan. The Downstream Metals, Video Production and Distribution Ecommerce are gaining wages but losing revenue and employment, which is strong indication with labor shortage. On the other hand, the Livestock Possessing has revenue gain and the wage goes down, an indication of an oversupply of manpower (Proposition 3).

Appendix 7. - District Cluster ID Scores

Cluster ID Scores	all 2LQ-LQ-ES-EG-RG-WG*	traded 2LQ-LQ-ES-EG-RG-WG*	local 2LQ-LQ-ES-EG-RG-WG*
North	3,019,005,031,043,040	2,013,003,022,033,030	1,006,002,009,010,010
Miao-Chu-Tao Northwest	3,012,003,041,046,020	3,011,002,029,035,020	1,001,012,011,001
Middle	7,023,006,038,048,010	7,018,003,028,036,010	5,003,010,012,000
Southwest	7,029,004,035,043,020	7,020,001,024,032,020	9,003,011,011,006
South	4,022,006,032,043,030	3,012,002,022,031,020	1,010,004,010,012,010
East	10,013,006,033,042,000	7,005,002,023,031,020	3,008,004,010,011,000
Outer Islands	8,013,008,039,035,020	6,003,004,025,026,020	2,010,004,014,009,010
Taiwan total	61,005,000,000,000	46,003,000,000,000	15,002,000,000,000

*Employment Shares is 5% or more.

2LQ=location quotient is 2; LQ=location quotient is 1; ES=cluster employment shares; EG=# of clusters with employment growth; RG=# of clusters with revenue growth; WG=# of clusters with wage growth

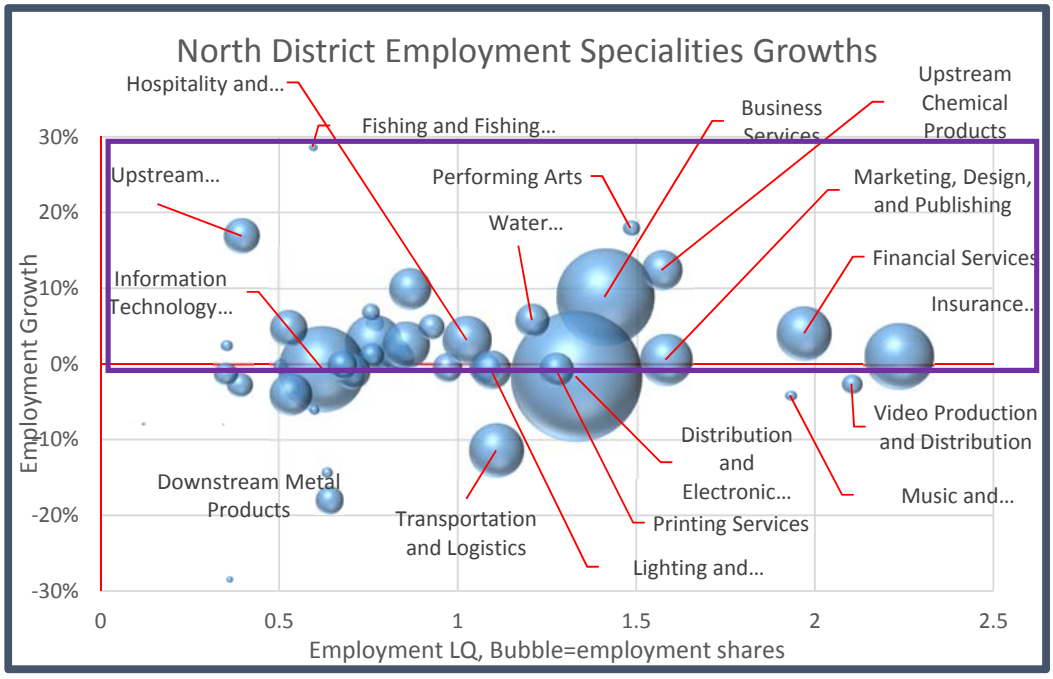
Appendix 8. - Regional Level Economic Analysis

The North District – Pei-Pei-Kee

In Figure 8, with an equal or more than 5% employment shares identifies the ID Score of 2,013,003,022,033,030. The North region has 2 highly specialized clusters (Insurance, Video Production and Distribution) with 3 major regional clusters (Business Services, Distribution and Ecommerce, IT). 13 other nationally contracted specialties.

Further looking in to the Specialty and Growth Map, we can digest more information.

Figure 86 North District Specialties & Growths.



Source: *Taiwan National Statistics Bureau*

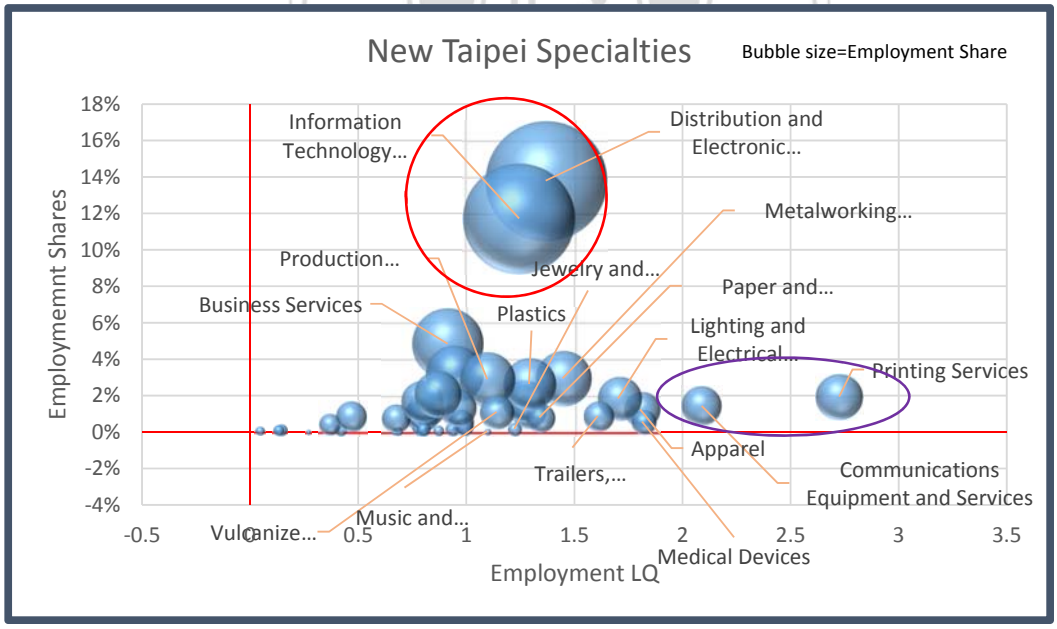
The purple boxed includes the growing specialized clusters. Only the Insurance Services cluster is the highly specialized and growing. The Business Service is the only cluster with national specialization and larger concentration which is growing in employment and revenue, but the wage is dropping, this can be an indication of oversupply of manpower. The Distribution and Ecommerce, the largest cluster, is declining with the employment, but the revenues and wages are all rising, and this is an indication of

undersupply of manpower. Although IT has a large employment concentration, but it is not high enough to make the national ratio. IT has a growing revenue and rising wages, but declining in employment also indicates the undersupply of manpower. In the field survey, the data confirm this shortage of manpower in the IT sectors. Many companies cannot find programmers for their web designs or app designs. The university school programs often lack of professors to train the latest programming languages, and students would have to learn on their own. From the above analogy, we can see more clearly where to find problems, and it sends a reasonable direction for solutions. The field survey helps to identify the causes.

Appendix 11.1.1. - New Taipei

From the Figure 8, New Taipei has a Cluster Identification (ID) Score of traded-cluster with regional 5% shares qualifications, the New Taipei is 2,015,002,022,034,020, and it reads as follows:

Figure 87: New Taipei Specialties.

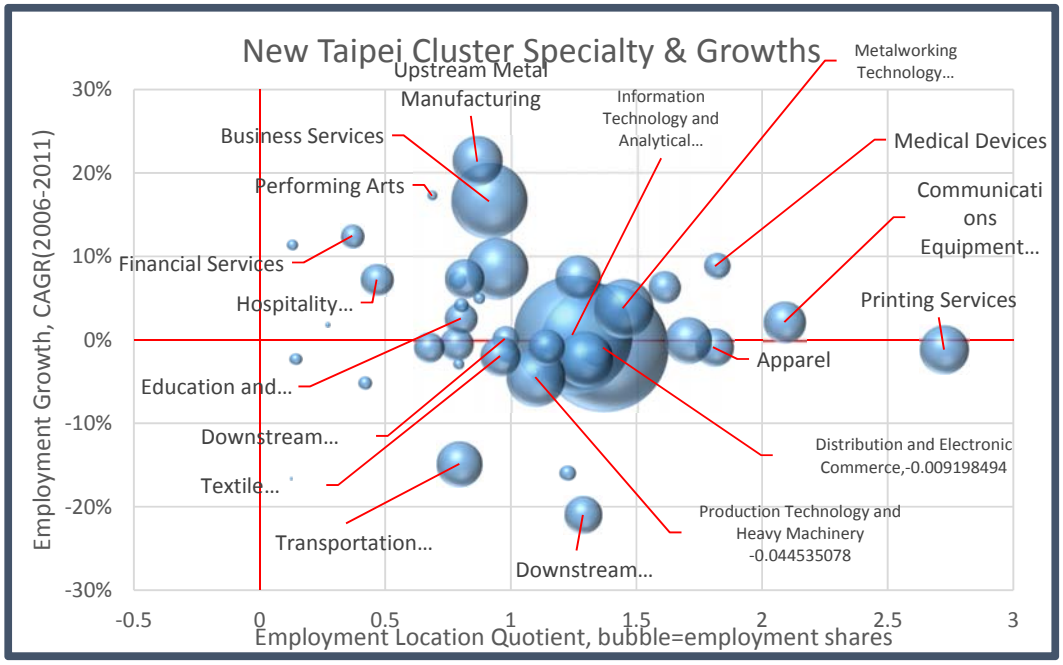


Source: *Taiwan National Statistics Bureau*

There are (in purple circle) highly specialized (Communication and Equipment Services, Printing Services) clusters, and both of these clusters have less than 2% regional

employment shares and stand out independently from other clusters. Furthermore, there are two (the 3rd sliced digit group from the left) regionally largest clusters (Information Technology and Analytical Equipment, Distribution and Electronic Commerce) has over 10% of regional employment shares. Reading to the right 3 digit groups, three are 20 clusters with employment growths, 34 clusters with Revenue growths, and 20 clusters with average wage growths out of total 46 active clusters. The revenue growths (over half of all the clusters) are doing better than the employment and wages. Below chart maps out the specialty and employment growths. The map shows as most of national concentrations are within LQ 1 to 2, and only 2 clusters are above 2 LQ.

Figure 88 New Taipei Specialty and Growths.



Source: *Taiwan National Statistics Bureau*

The highest growing cluster in New Taipei is the Upstream Metal Manufacturing followed by Performing Arts (small but high growth) and Business Services (5% shares and high growth, not a specialization). The map gives us an instant realization what are the most active, larger specialties, and their growth momentum. The Search Score provides many details about the cluster positioning and growth. The growth rates provide the dynamics of clusters which is very important for businesses and policy makers to plan

for their initiatives. For example, the Business Service cluster has a high momentum for growth, a cluster initiative can aide the development.

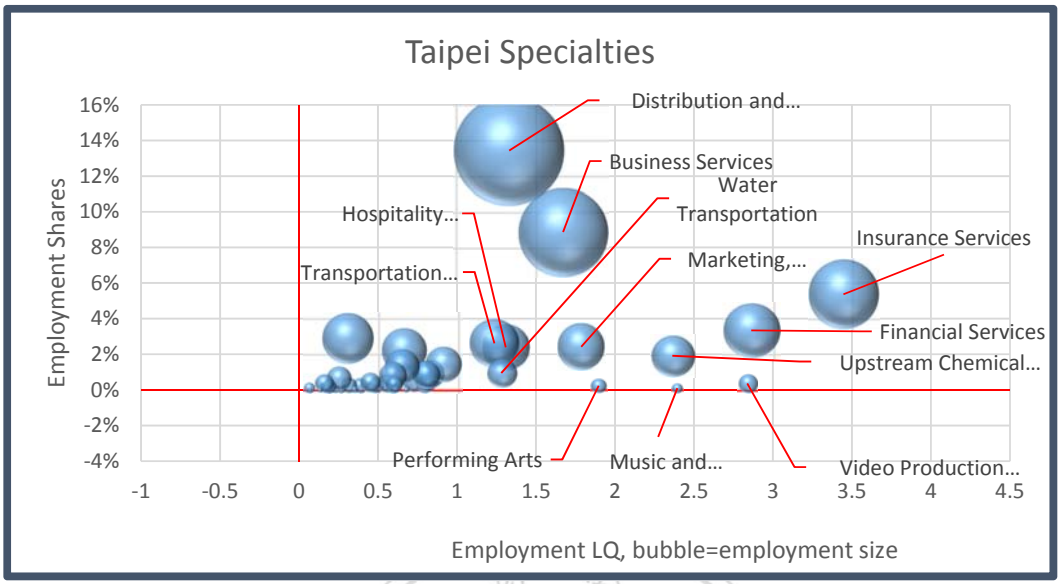
From the above two charts and the Cluster ID Score, we can summarize that New Taipei is more diversified. 2 large clusters are stagnated in growth, and the high growth clusters are mostly not in the national concentrated enough to be in the national specializations such as Business Services, Upstream Metal Manufacturing, and Performing Arts, which are more than 10% growths but less specializations. The higher growing specialized clusters are Marketing Design and Publishing; Metalworking Technology; Medical Devices; Trailer Motor Homes, and Appliances, which have faster growing rates of over 5%, but they are smaller clusters, shares less than 2%. The two highly specialized clusters are with slow growth (Communications Equipment and Services) or in decline (Printing Services).

Appendix 11.1.2. - Taipei City

Taipei has a population size of 2.7 million and has the highest density of 9,753 per km² among all the Cities. With a 5% employment share qualifications on the ID Scoring, Taipei has a Cluster ID Score of 5,007,003,024,032,030. This means Taipei has 12 (5+7) specialized clustered, and 5 of them are heavily specialized in Taipei. These highly specialized 5 clusters are Business Services; Distribution and Electronic Commerce; Financial Services, Information Technology and Analytical Instrument; Insurance Services. There are 3 clusters with more than 5% of regional employments, and they are Business Services; Distribution and Electronic Commerce; Insurance Services. Notice that there is an overlap of Business Services in both categories which implies that Business Services cluster is important for Taipei, and the cluster is very close to become a specialization of Taipei with its projected growing rates.

Below is Taipei's cluster map.

Figure 89 Taipei Specialties.

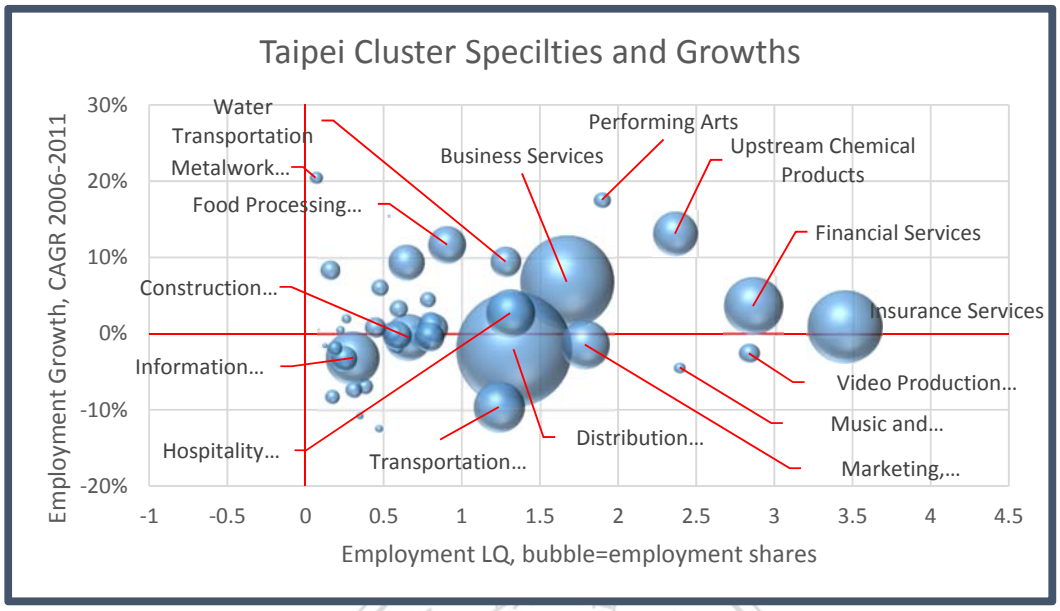


Source: *Taiwan National Statistics Bureau*

Among the three clusters over 5% shares, the Insurance Services cluster (LQ>3) is especially highly concentrated in Taipei in accordance to the national ratio. There dominated cluster over 10% regional employment shares, and that is Distribution and Electronic. Within 5 highly specialized clusters, only Insurance is over 5% regional employments. The rest are 4% shares or less. These are mostly independent clusters which are not highly related to the rest of clusters in the region.

Below is the Taipei Specialty and Growth map, and we can use it to tell more from the dynamics of Taipei.

Figure 90 Taipei Specialties and Growths.



Source: *Taiwan National Statistics Bureau*

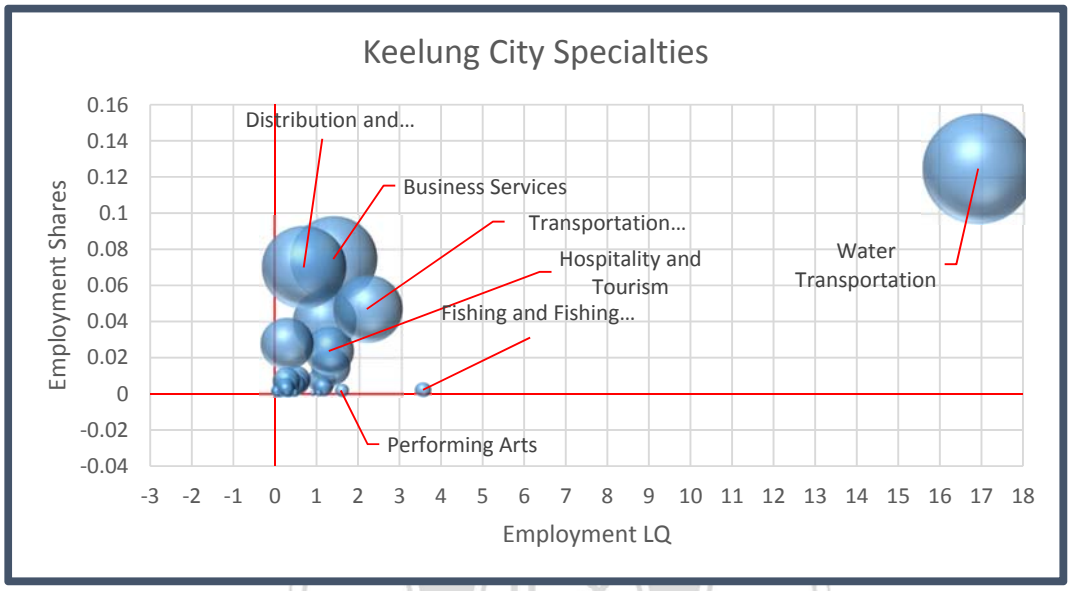
From, Figure 90,Taipei Specialties and Growths Chart, one cluster stands out is the Business Services cluster, it is not only regionally and nationally important, it is also growing more than 5% rates. The two fast growing specialties are Performing Arts and Upstream Chemicals. There are some smaller clusters outside of specialties growing over 10% rates, and they are Metalworking Technology, and Food Processing and Manufacturing. The alarming declining Clusters are the Distribution and Electronic Commerce, and Transportation and Logistics which are nationally important and the bigger clusters in Taipei. According to Figure 47, The Transportation and Logistics has an overall employment decline of 8%. A cluster analysis will be able to point out the reason for a direction.

Appendix 11.1.3. - Keelung City

Keelung has a population of 379,927 and is a smaller City. It borders Taipei being a part of North District, and has an important port. With 5% or more employment shares, Keelung has an ID Score of 3,008,003,023,029,020 meaning there are 3 very specialized clusters and 8 more national concentrated clusters, and with 3 regional clusters that are

over 5% employment shares. 23 clusters have employment growths; 29 clusters have revenue growths, and 20 clusters have wage growths. From below Keelung Specialty Chart: Water Transportation is big and concentrated.

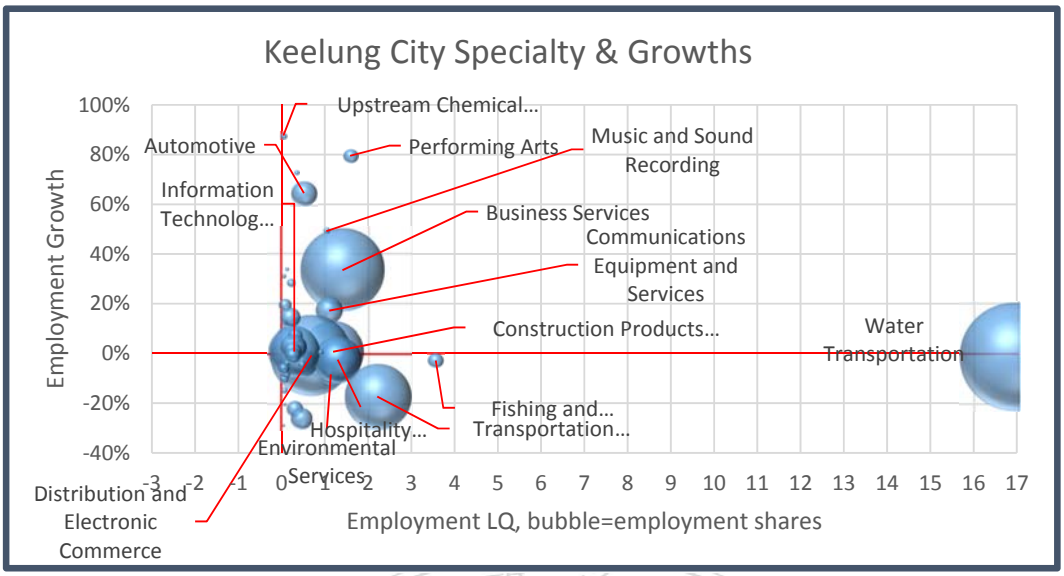
Figure 91 Keelung Specialties.



Source: *Taiwan National Statistics Bureau*

The three very specialized clusters are Business Services, Distribution and Electronic Commerce, and Water Transportation. The regional concentrated specialties are Finishing and Fishing Products, Transportation and Logistics, and Water Transportation where Water Transportation is highly specialized regionally and nationally. The Water Transportation is an extremely specialized cluster with LQ > 16. It's employment shares is over 10% which dominates in the City. The other two larger clusters are Distribution and Electronic Commerce, and Business Services which are over 5% employment shares. By looking at the growth map below, we will see more dynamics.

Figure 92 Keelung City Specialty & Growths.



Source: *Taiwan National Statistics Bureau*

From the cluster map in Figure 92, the Water Transportation carries the heaviest weight for both regional and national presence. It is obviously the specialized focus for Keelung, but it is facing a small decline. Two other highly specialized clusters are Transportation Logistics and Fishing Businesses, and they are both declining. We are seeing these highly specialized clusters all related to the local lifestyle which has to do with the Ocean port. In the meantime, all these three very specialized clusters are declining. Two other specialties are also declining and they are Hospitality and Tourism, and Environment Services. IT and Distribution Ecommerce clusters are remaining stable. High growth and significant clusters are Performing Arts, and Music and Sound Recoding, but they are many smaller clusters which have less impact on employment. The Business Cluster is the one that is growing with an over 30% rates, and is large enough with the employment impact. The Communication and Electronic Commerce is also growing close to 20% which can be impactful to the Keelung. The Automotive cluster is on the rise but not yet reaching the national ratio performance. It is worth extra research on the causes of the growths and declines by using the Diamond framework. It will provide a more thorough analyses and give recommendations to start a competitive initiative for the City.

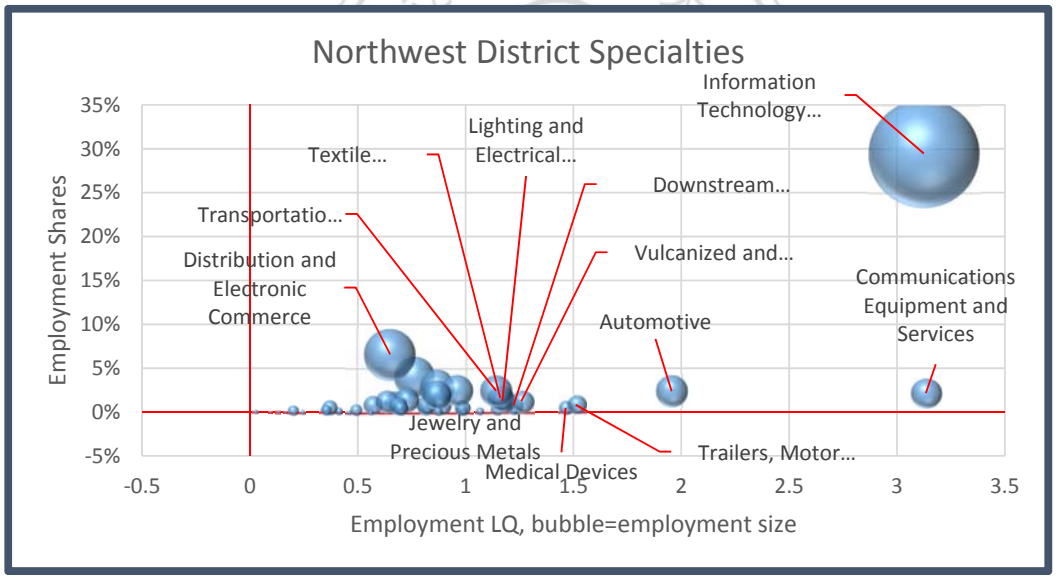
Northwest – Tao-Chu-Miao District

This is a region with IT and high-tech development. Hsinchu Science Park is the major area hub for the technology development along with two important engineering science Universities. This cluster is also a well-connected with Silicon Valley. The International airport hosts most international passenger flights and the air transportation logistics for goods.

With the above 5% employment concentrations, the ID Score is: 3,011,002,029,035,020.

It interprets to be 3 highly national specializations, and 2 large concentrated clusters regionally.

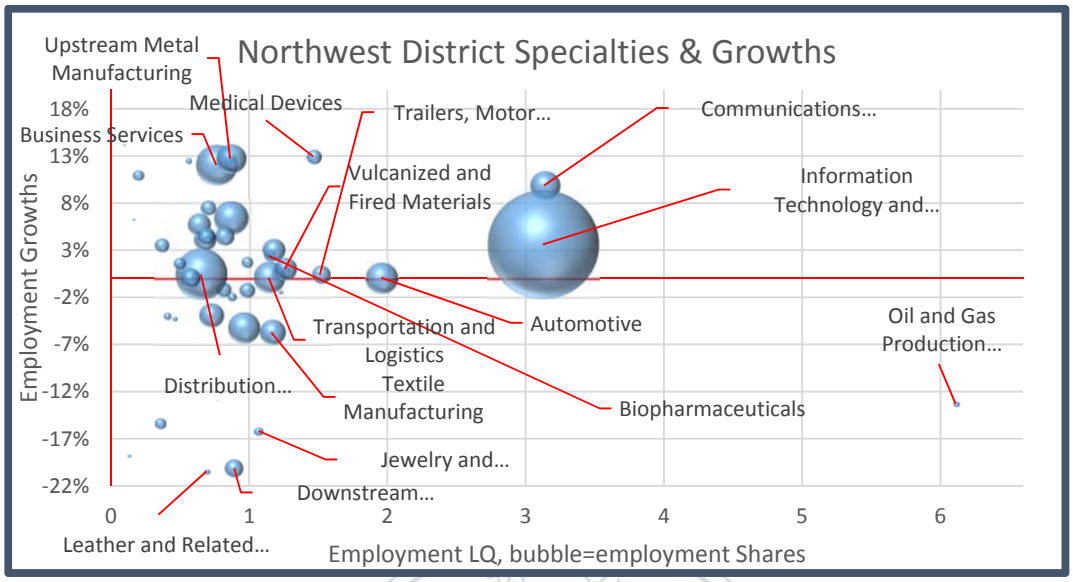
Figure 93 Northwest District Specialties.



Source: *Taiwan National Statistics Bureau*

From Figure 93, it is very obvious that the IT cluster dominates the City. The highly specialized clusters are Communication Equipment and Services, IT, and Oil and Gas Production and Transportation, and the 2 largest clusters are Distribution and Ecommerce and IT. The IT, about 30% employments of the region, is a highly specialized and regionally concentrated cluster. By looking at the cluster map below, IT obviously stands out of the rest of the group, but smaller clusters are also growing.

Figure 94 Northwest District Specialties & Growths.



Source: *Taiwan National Statistics Bureau*

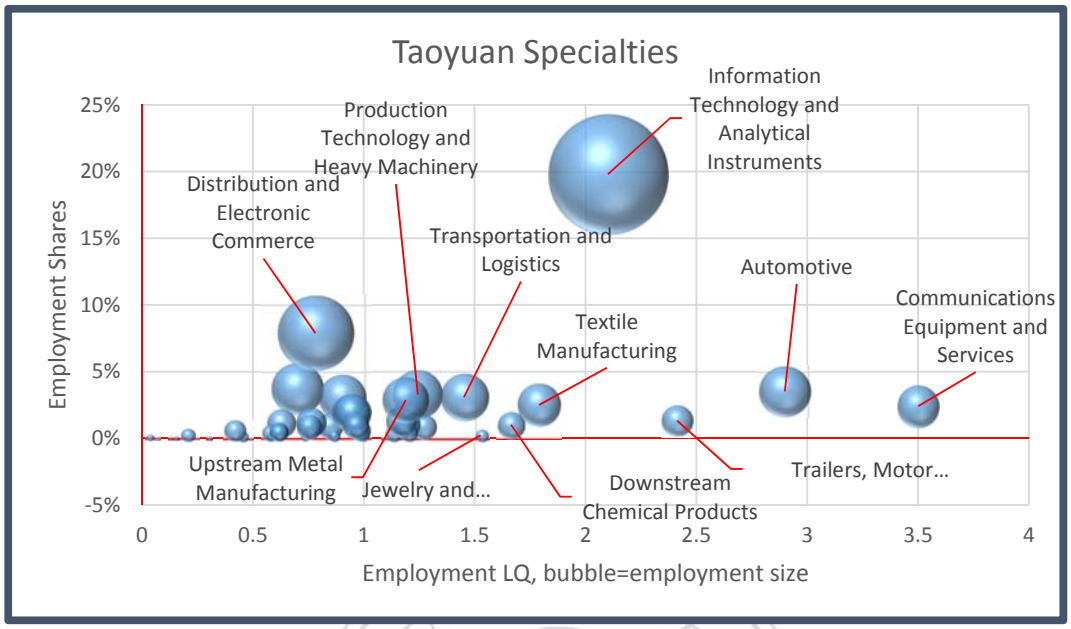
From the growing factors, Business Services, Upstream Metal Manufacturing, and Medical Devices are the higher growing clusters. Oils and Gas Production and Transporter cluster although is heavily specialized in the region, but is a much smaller cluster and declining. The second largest cluster is the Distribution and Ecommerce, and it does not have enough representation nationally to be qualified as the specialized cluster in the region.

From this region, below are the 4 city-level evaluations. These are Taoyuan City, Hsinchu City, Hsinchu County, and Miaoli County.

Appendix 11.2.1. - Taoyuan City

Taoyuan has a population of 2,013,305. The cluster ID Score is 4,011,002,029,031,030. There are 4 (Automotive, Communication Equipment and Services, IT, Trailers, Motor Homes, and Appliances) highly specialization and 2 (Distribution and Ecommerce, IT) larger regional clusters.

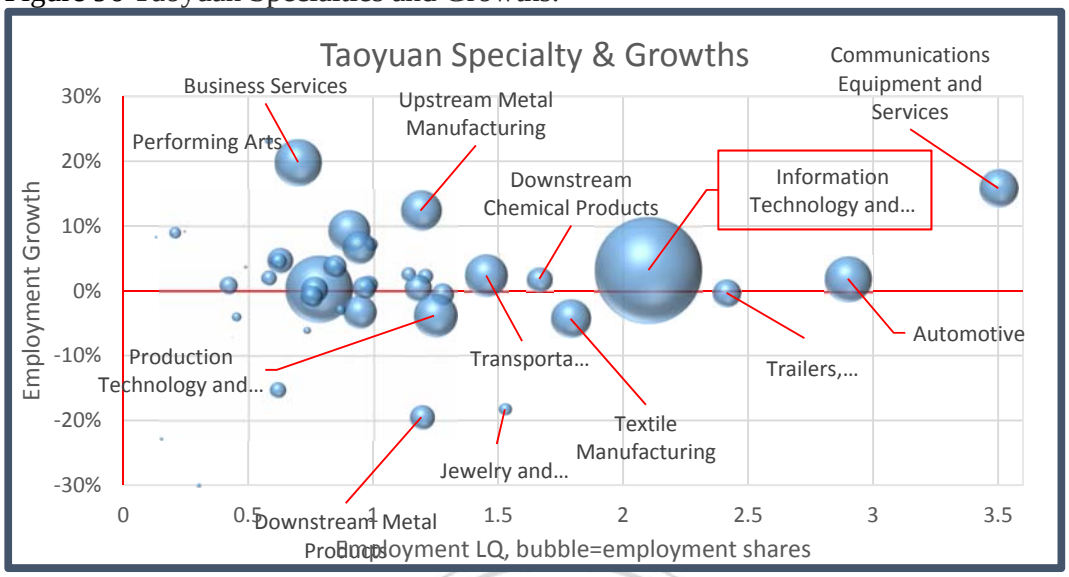
Figure 95 Taoyuan Specialties.



Source: *Taiwan National Statistics Bureau*

IT Dominates the City with 20% of employment in the City. The second largest cluster is Distribution and Ecommerce. There are many other smaller specialization clusters below 5% labor participation.

Figure 96 Taoyuan Specialties and Growths.



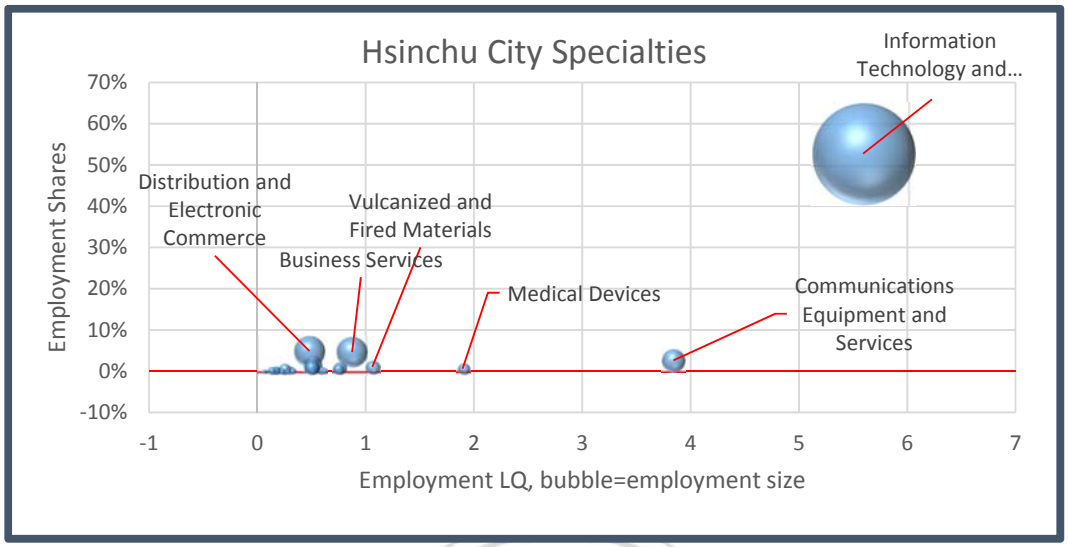
Source: *Taiwan National Statistics Bureau*

By looking at the growth chart, Communication Equipment and Services, and Upstream Metal Manufacturing are two specialized clusters with higher growths. The Communication cluster is a highly specialized cluster in the City, and the Business Services has not yet made to the national concentrations, but its momentum is very strong.

Appendix 11.2.2. - Hsinchu City

Hsinchu has a population of 420,052 and has the cluster ID Score of 2,002,001,020,025,030. There are 2 (Communication Equipment & Services, IT) highly specialized clusters with only 2 (Medical Devices, Vulcanized and Fire Materials) other small specialized clusters.

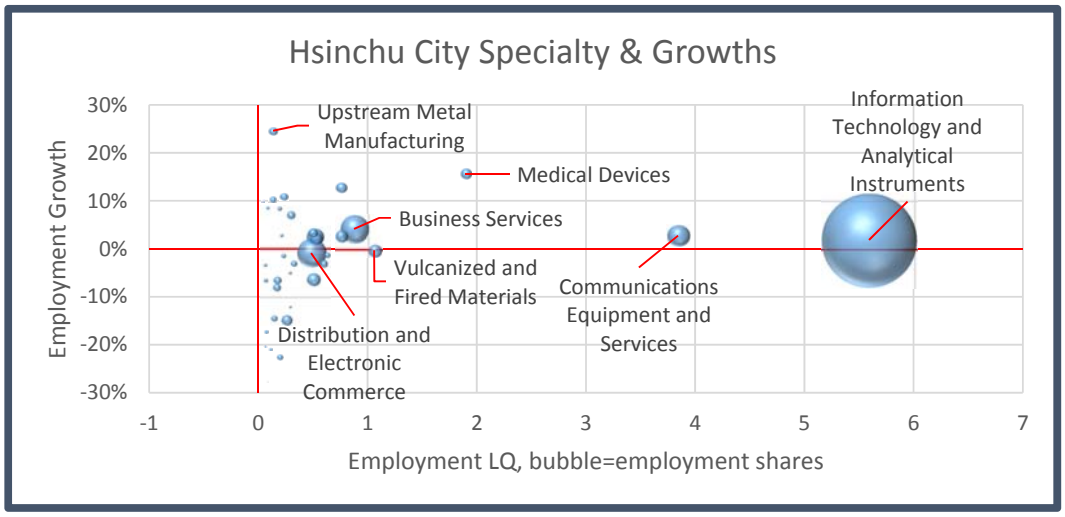
Figure 97 Hsinchu City Specialties.



Source: *Taiwan National Statistics Bureau*

IT dominates the City with an over 50% workforce. This is the IT town of Taiwan. Communications and Equipment and Services is another highly specialized cluster, and it is a very small cluster. This cluster is closely related to the IT cluster. The Medical Services and Vulcanized Fired Materials are other specialized clusters. Two other larger regional clusters, Business Services, and Distribution and Electronic Commerce are larger ones but still substantially smaller than the IT.

Figure 98 Hsinchu City Specialties and Growths.



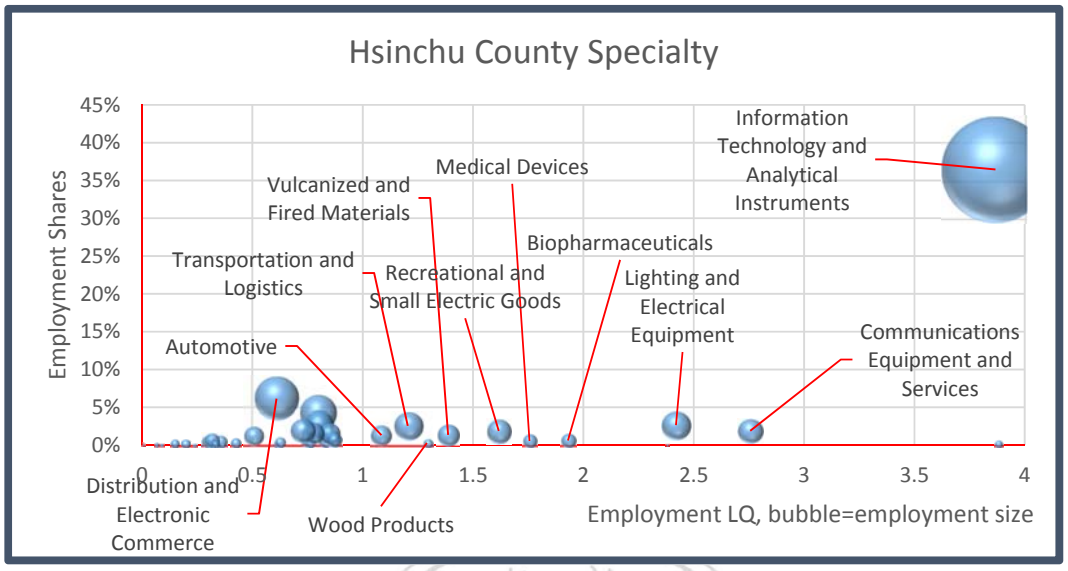
Source: *Taiwan National Statistics Bureau*

In this city, the number of clusters with wage growth is over the number of clusters in revenue and employment growth. The highest growing national cluster is Upstream Metal Manufacturing. Other specializations have slow growths. The Business Services cluster is close to the national concentration and has a higher growth rate. There are other smaller clusters with higher growth but the size is negligible. The Distribution and Ecommerce is at a decline which is worth further study.

Appendix 11.2.3. - Hsinchu County

Hsinchu County has a population of 517,641 and Cluster ID Score of 5,007,002,031,030,020. It has 5 (Communication Equipment and Services, IT, Lighting and Electric Equipment, Metal Mining, Non-metal Mining) highly specialized clusters and 2 (Distributions and Ecommerce, IT) large clusters. There are more clusters with growing rates in employment, almost equivalent to the revenue growth, but less in wage growth.

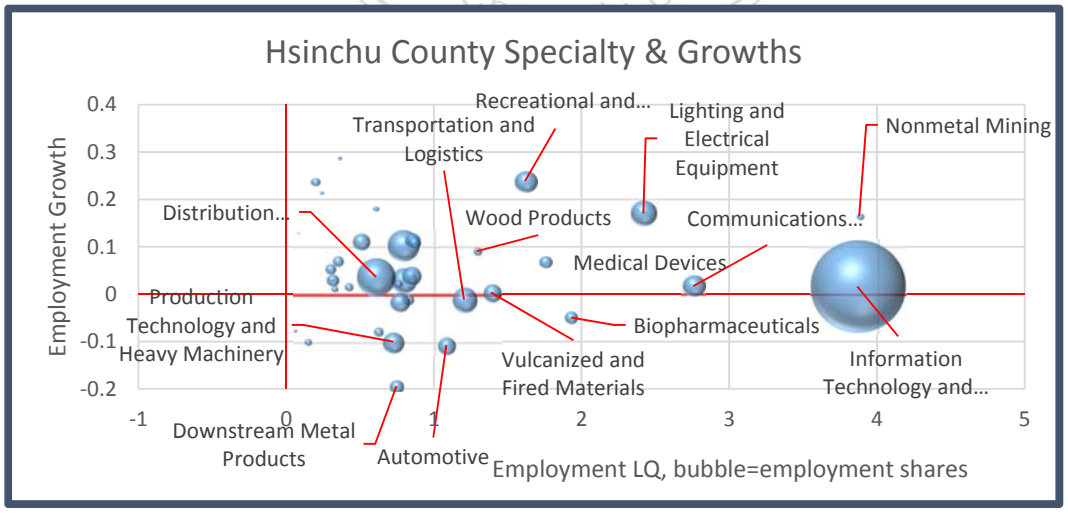
Figure 99 Hsinchu County Specialties.



Source: *Taiwan National Statistics Bureau*

IT dominates the City with an over 35% workforce. Recreational and Small Electric Goods, Lighting and Electrical Equipment, Wood Products, and Medical Devices also have national importance. 3 declining clusters are Transportation and Logistics, Biopharmaceuticals, and Automotive. Other specialized clusters remain healthy.

Figure 100 Hsinchu County Specialties and Growths.



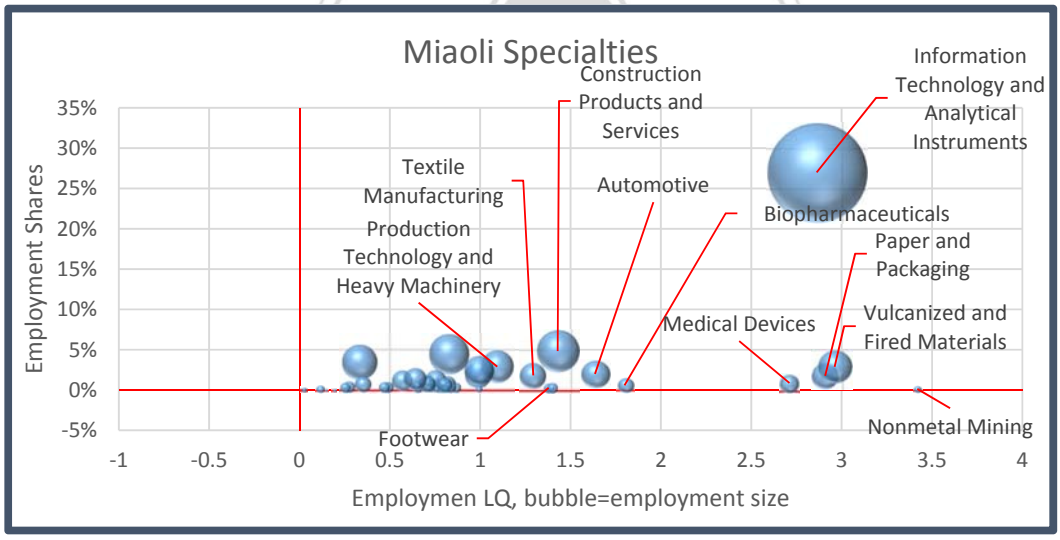
Source: *Taiwan National Statistics Bureau*

The IT cluster is not growing, and the growing clusters are Recreational and Small Electrical Goods, Lighting and Electrical Equipment, and other smaller clusters. There are some declining clusters worth noticing, and they are Downstream Metal Productions, Production Technology and Heavy Equipment, Transportation and Logistics, and Automotive.

Appendix 11.2.4. - Miaoli County

Miaoli has a population of 562,010 and a Cluster ID Score of 7,007,001,024,030,020. It has 7 (Oil and Gas Production and Transportation, IT, Leather and Related Products, Nonmetal Mining, Paper Packaging, Vulcanized and Fire materials, Medical Devices, Automotive) highly specialized clusters with one (IT) regional cluster that is over 5% employment shares.

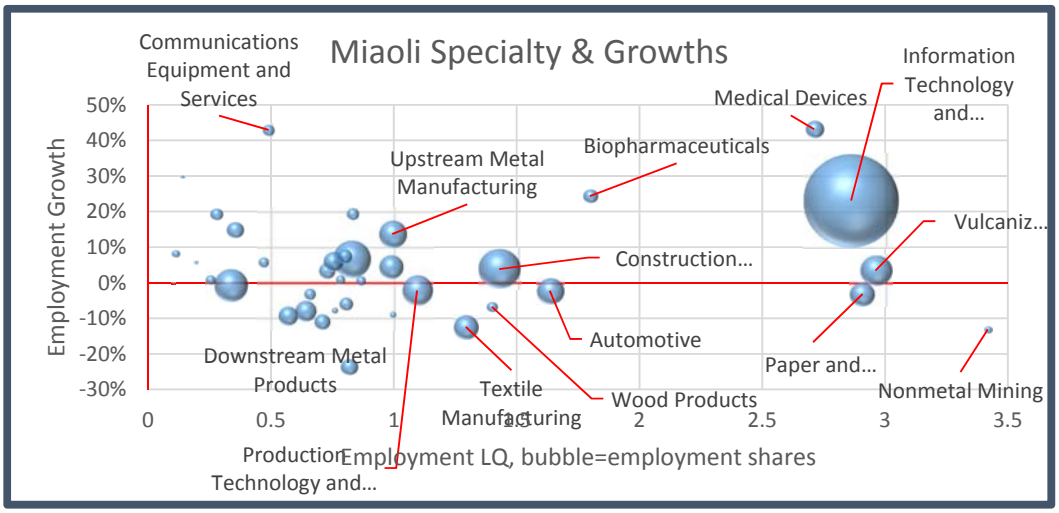
Figure 101 Miaoli Specialties.



Source: *Taiwan National Statistics Bureau*

IT dominates in the City with over 25% of labor participation. Construction and Products and Services is the next larger specialty with 5% workforce.

Figure 102 Miaoli Specialty and Growths



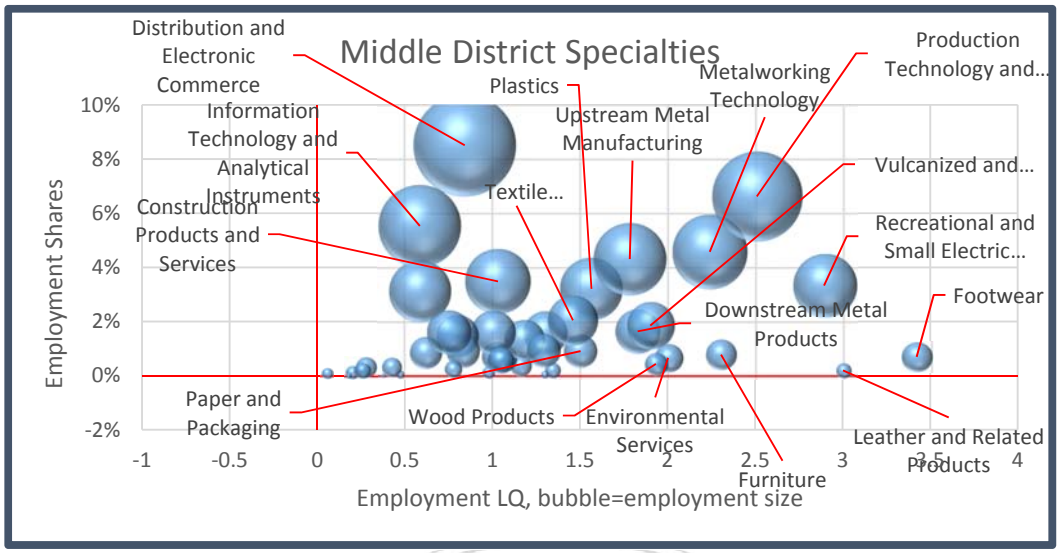
Source: *Taiwan National Statistics Bureau*

The largest IT cluster is growing at a 23% rates which is a very healthy growth. In the specializations, Medical Devices is also growing very high, over 40%, and Biopharmaceuticals are growing over 20%. Upstream Metal Manufacturing is growing over 10%. The declining specializations are Textile Manufacturing, Production Technology and Heavy Machinery, Wood Products, Automotive, Paper and Packaging, and Nonmetal mining. The worst decline is the Downstream Metal Products.

Middle – Chung-Chang-Tou District

Has a population of 4,490,240 and has a Cluster ID Score of 7,018,003,028,036,010. There are 7 (Environmental Services, Footwear, Furniture, Leather and Related Products, Metalworking Technology, Production Technology and Heavy Machinery, Recreational and Small Electric Goods) highly specialized clusters, and 3 (Business Services, Distribution and Ecommerce, IT) large regional clusters. This region has more clusters with revenue growth, but the wage growths are not so competitive. The region also has 18 other specialties which matches national ratio thus a more diversified region.

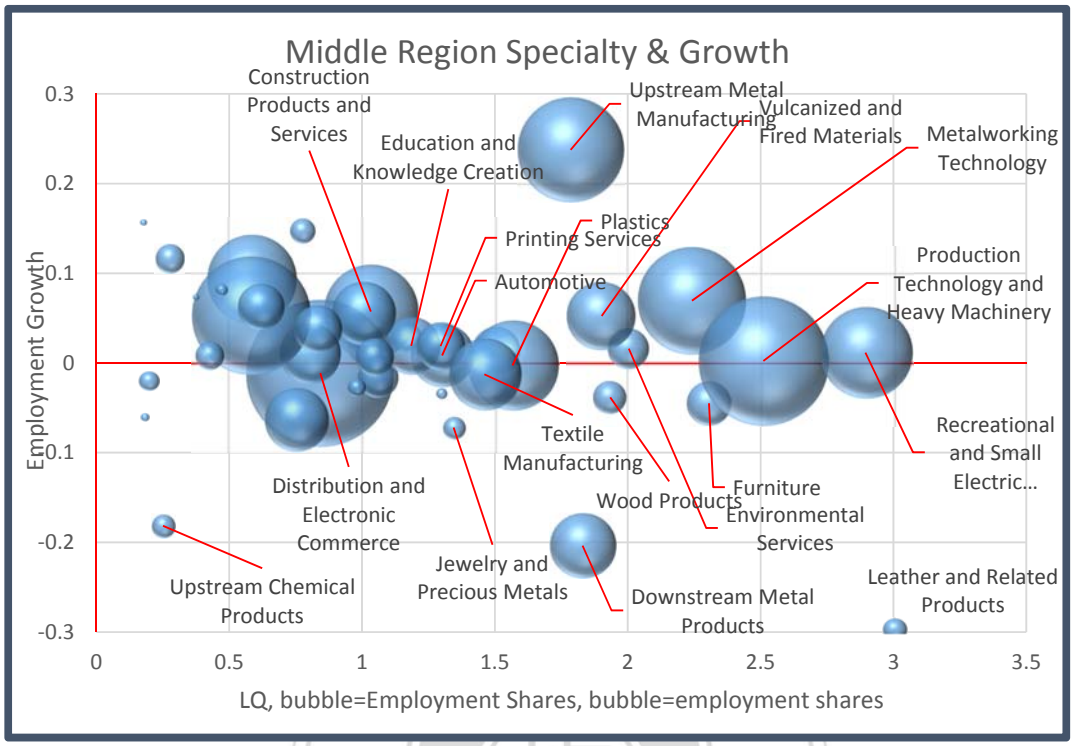
Figure 103 Middle District Specialties.



Source: *Taiwan National Statistics Bureau*

This region is famous for its production machinery and machine tool industries. Over 90% of companies are Small and Medium Enterprises (SMEs), and most of them are part of industry value chain. From the specialty map, we can see the Metalworking Technology, Upstream Metal Manufacturing, Production Technology and Heavy Machinery, Vulcanized and Fired Materials, are in the upstream machine tooling businesses, and Downstream Metal Products, Textile Manufacturing, Footwear, Furniture, Paper and Packaging are downstream products of machine tools. There no dominated cluster in this region. All the clusters are below 10% shares. The largest is the Distribution and Electronic Commerce barely made to the national specialization. Neither IT is a specialization in this region. The only large and specialized cluster is the Production Technology and Heavy Machinery. This region is very different from the previous two north regions. The North is more focusing on business with two dominated clusters, and the Northwest is highly dominated by IT.

Figure 104 Middle District Specialties and Growth.



Source: *Taiwan National Statistics Bureau*

The Upstream Metal Manufacturing has the employment growth rate over 20%, and Metalworking Technology is growing close to 10%, but the Downstream Metal Products declines at a 20% rates. Furniture and Wood Products are declining close to 5% rates. Other regional clusters are equally important because they are mostly part of this manufacture tooling supply-chain. It is interesting to see the Upstream and Downstream Metals products are splitting in two different growth direction. Further research may be called with a cluster analysis to derive a cluster initiative.

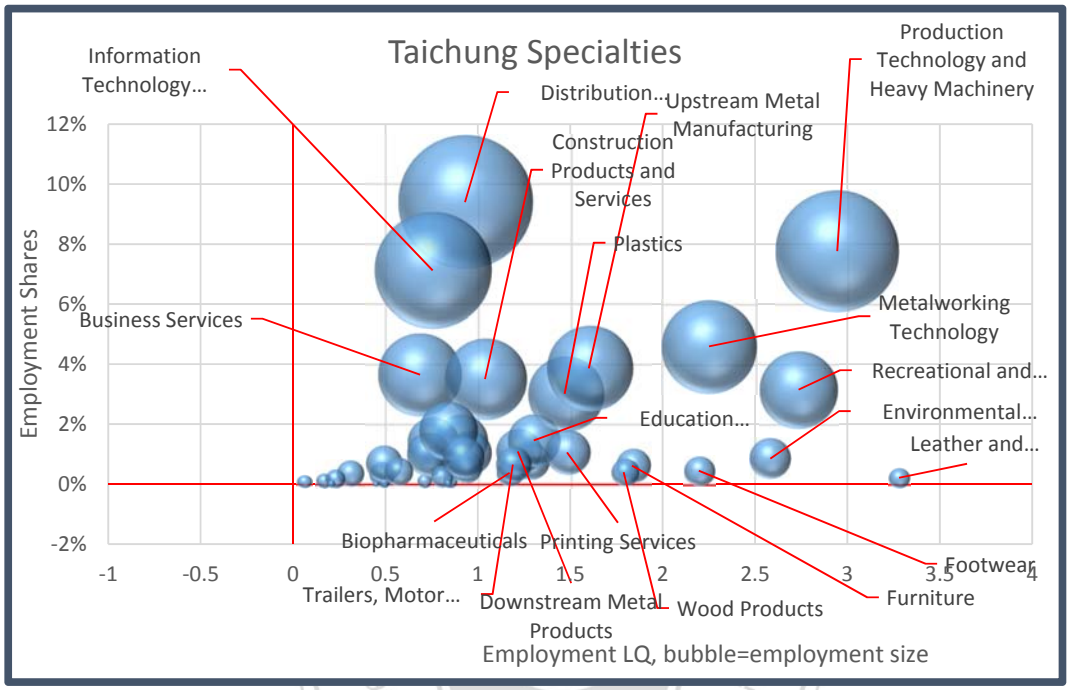
Within the Middle Region, the cities are Taichung City, Changhua County, and Nantou County. Below are the analyses for the city-regions.

Appendix 11.3.1. - Taichung City

Taichung has a population of 2,664,394 and a Cluster ID Score of 6,011,003,030,035,030. There are 12 (Environmental Services, Footwear, Leather and Related Products, Metalworking Technology, Production Technology and Heavy

Machinery, Recreational and Small Electric Goods) highly specialized clusters and 3 (Distribution and Ecommerce, IT, Production Technology and Heavy Machinery) large regional clusters that are over 5% employment shares.

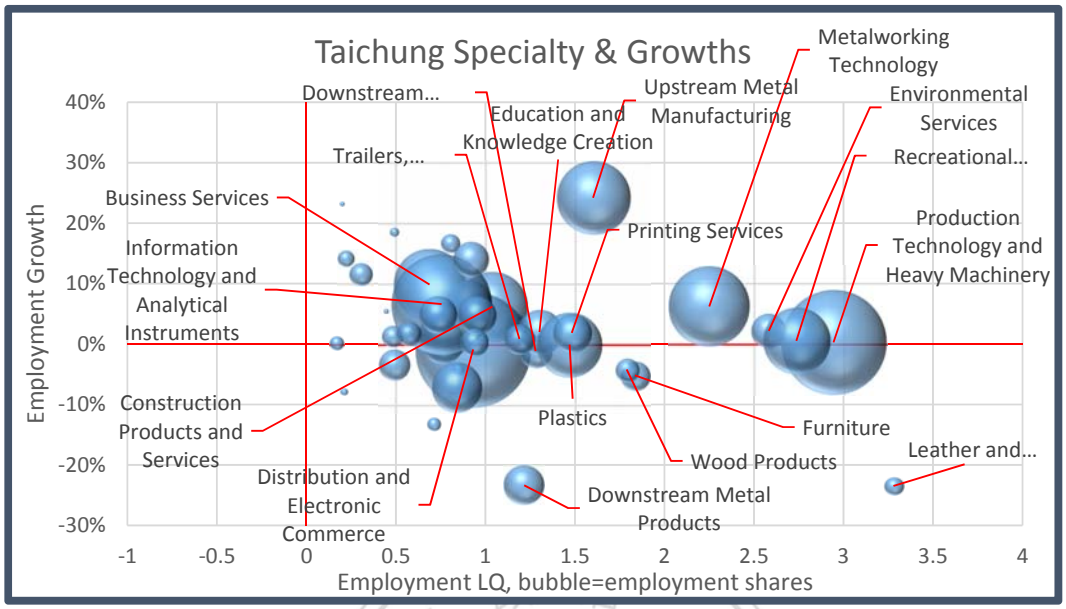
Figure 105 Taichung Specialties.



Source: *Taiwan National Statistics Bureau*

A total of 17 national specialties concentrations makes the City very diversified, and most clusters are evenly populated which give an indication that clusters are spread out in this City, and they are within a closely tied value-chain by the related type of clusters. This City has a supply-chain clusters which means that clusters are supportive of each other; therefore, we will be able to see the growth rates are very similar in a group of clusters.

Figure 106 Taichung Specialty and Growth



Source: *Taiwan National Statistics Bureau*

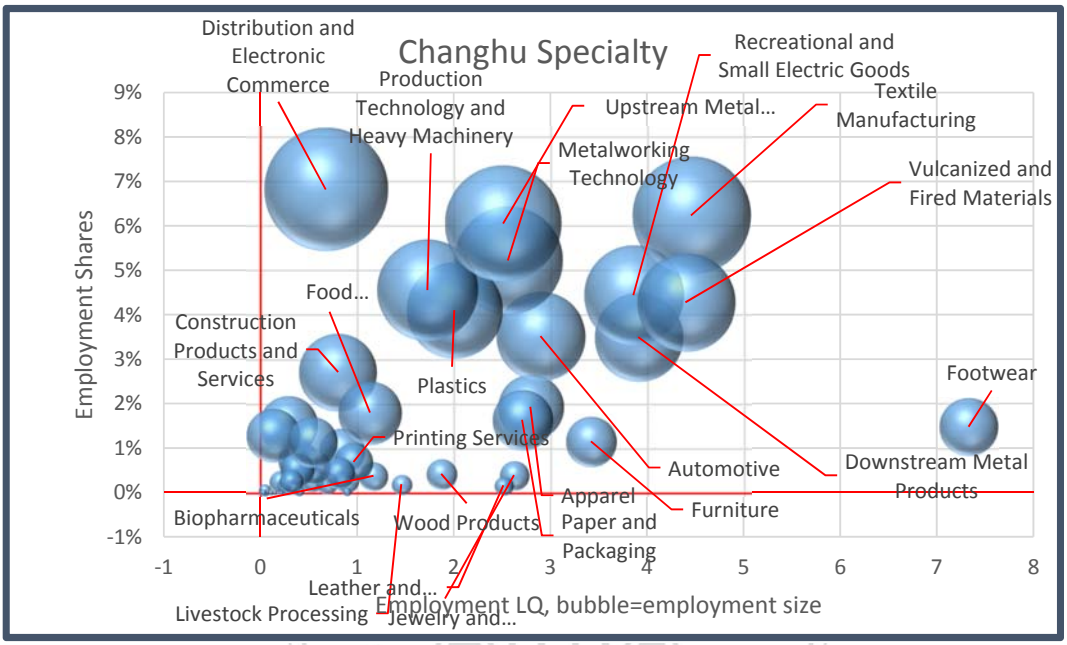
Notice from Figure 106 that the leading cluster of Production Technology is not growing. Looking at the growth rates of the clusters, the highest growth is the Upstream Metal Manufacturing among the regional and national specialties followed by Metalworking Technology. Other national specialties remain slow growths and some declining. The declining clusters are mostly downstream products such as Furniture, Wood Products, Plastics, and both Leather and Related Goods, and Downstream Metals are the worst declines. It is noticeable that the production value-chain is splitting into two extremes. The upstream technology and tooling are growing, but the downstream productions are declining. It will take further analysis to understand the causes. A cluster initiative then can take place.

Appendix 11.3.2. - Changhua County

Changhua has a population of 1,303,039 and a Cluster ID Score of 14,005,004,028,032,000. It has 14 (Apparel, Automotive, Downstream Metal Products, Footwear, Furniture, Jewelry and Precious Metals, Leather and Related Products, Metalworking Technology, Paper and Packaging, Plastics, Recreational and Small Electric Goods, Textile Manufacturing, Upstream Metal Manufacturing, Vulcanized and

Fired Materials) highly specialized clusters and 4 (Distributions and Ecommerce, Metalworking Technology, Textile Manufacturing, Upstream Metal Manufacturing) larger regional clusters are over 5% employment shares.

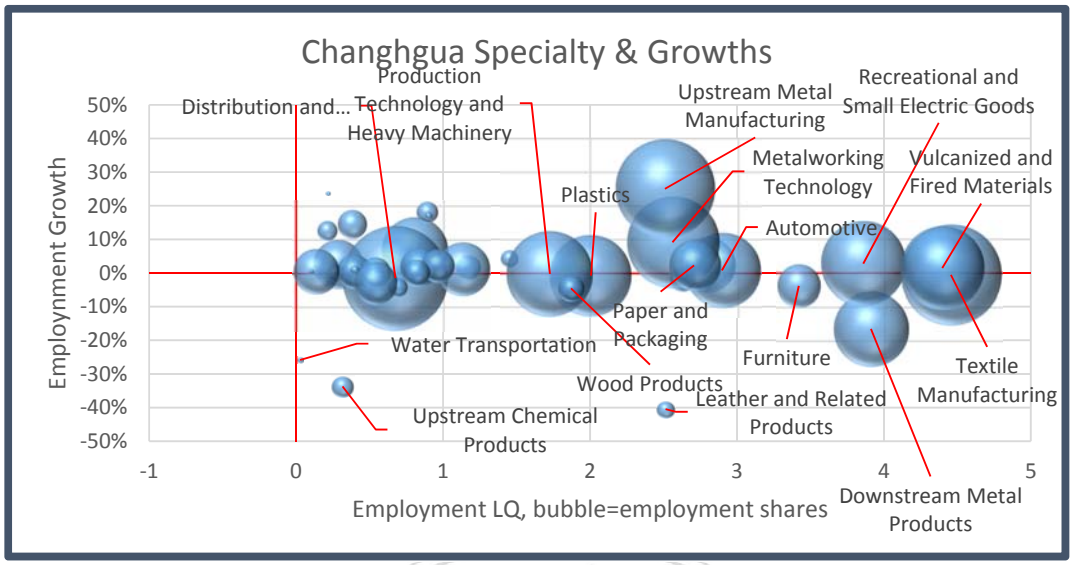
Figure 107 Changhua Specialties.



Source: *Taiwan National Statistics Bureau*

The employment evenly spread out the nationally important clusters, and 3 out of 4 regionally large clusters are national significant. Notice that there is a split between the Upstream and Down Stream products at the LQ 3. These was at the District level that we notice a growth rates splitting.

Figure 108 Changhua Specialties and Growths.



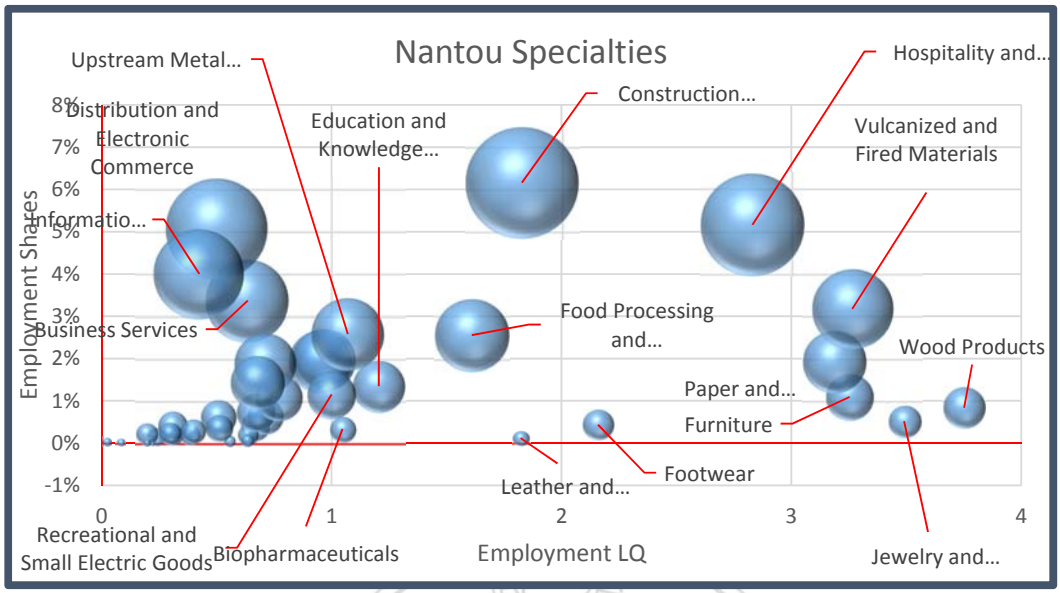
Source: *Taiwan National Statistics Bureau*

This City has the similar cluster mapping with the previous City, Taichung. They have the evenly distributed clusters, highly specialized within the production technology value-chain. Likewise, with Taichung's growth factors, the Upstream Metal Manufacturing and Metalworking Technology is on a healthy growth, but the Downstream Metal Products cluster is declining sharply. The downstream production clusters are mostly facing a down-turn. This may have been impacted by the supply-chain migration that many manufactures have left the area to cheaper labor countries like Vietnam or Indonesia for the production floor. A future research maybe conducted to confirm this.

Appendix 11.3.3. - Nantou County

Nantou has a population of 522,807 and a Cluster ID Scores for Nantou of 8,007,003,024,028,020. There are 8 (Footwear, Furniture, Hospitality and Tourism, Jewelry and Precious Metals, Nonmetal Mining, Paper and Packaging, Vulcanized and Fired Materials, Wood Products) highly specialized clusters and 3 (Construction Products and Services, Distribution and Ecommerce, Hospitality and Tourism) large regional clusters with over than 5% employment shares.

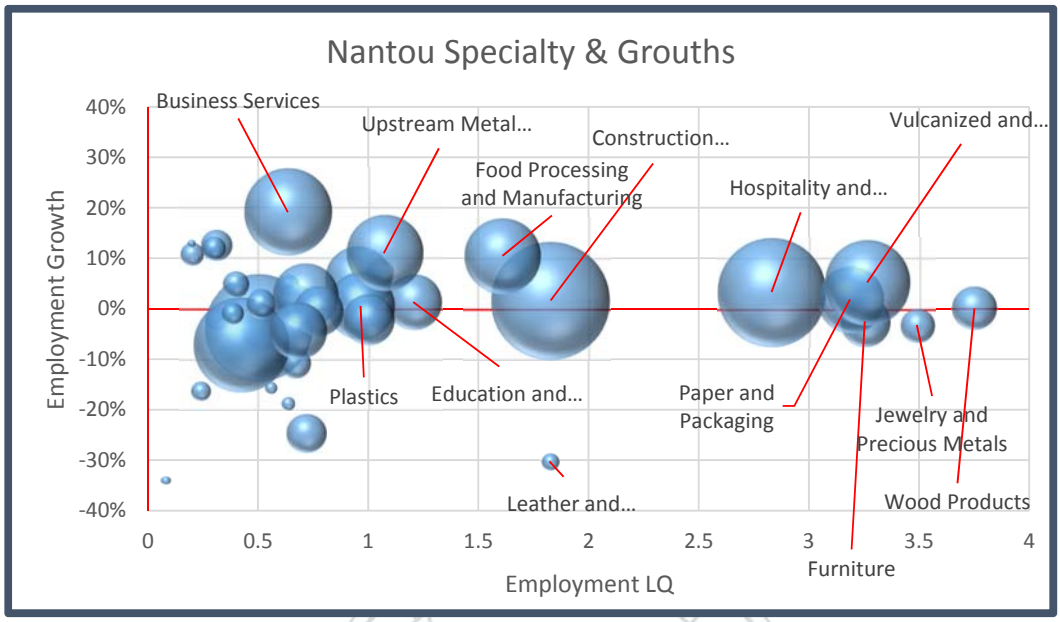
Figure 109 Nantou specialties.



Source: *Taiwan National Statistics Bureau*

The City is highly specialized in Hospitality and Tourism. Nantou is a remote City sits in the middle of mountain ridges with forestry and a famous resort of Sun Moon Lake. It is a major tourist attraction. The Hospitality and some handcraft products are embedded in the local lifestyle; therefore, those clusters are highly specialized such as Vulcanized and Fired Materials, Wood Products, Furniture, Paper Packaging Materials and Jewelry and Precious Metals. Other clusters remain value-chain networked clusters in production which is more connected with the rest of the District.

Figure 110 Nantou Specialties and Growths.



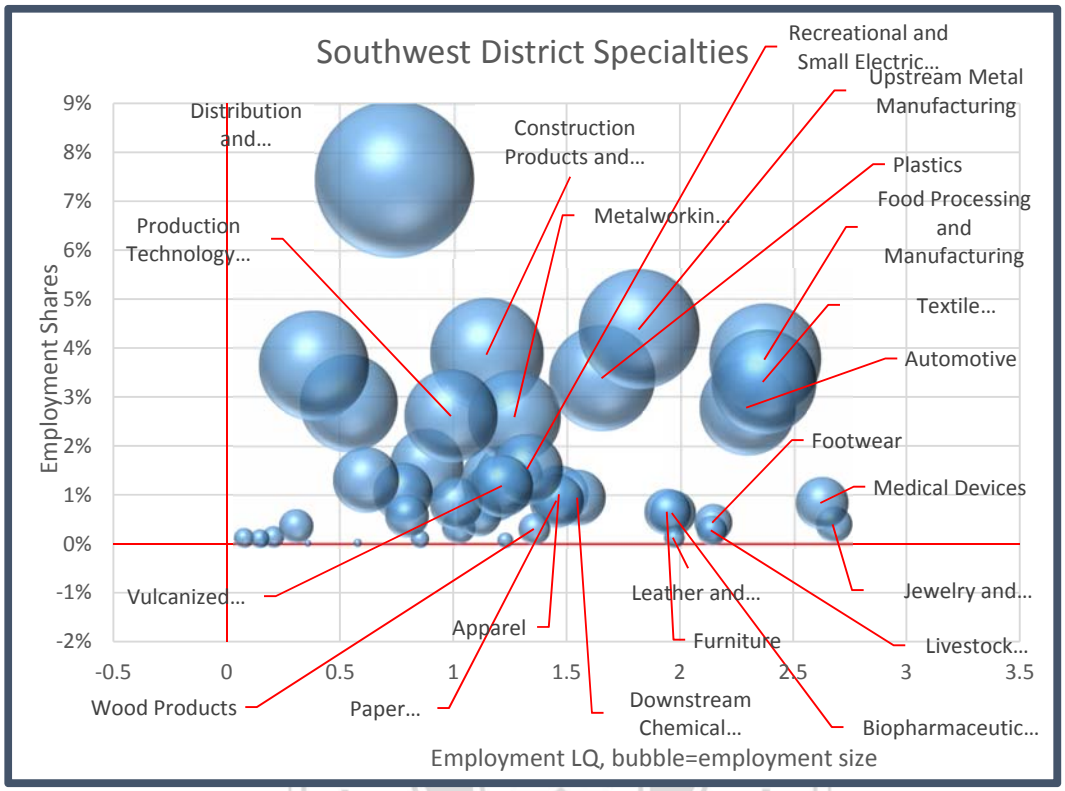
Source: *Taiwan National Statistics Bureau*

Food Processing and Manufacturing has the highest growth among national specialties, and Business service has the highest growth in the region and is less than the national specialty ratio. From the growth ratios, Nantou has a different landscape than its neighboring cities, Changhua and Taichung. Nantou is a valley, separated from the flat land of Changhua and Taichung, the geographical divider makes Nantou its unique specializations. Sun Moon Lake is the major tourist attraction in the County; therefore, Tourism is an important regional and national specialization with a high growth. The latest ECFA brought many Chinese here, which brought the growth to the area.

Southwest –Yun-Chia-Nan District

Southwest District has a population of 3,399,984 and a Cluster ID Score of 7,020,001,024,032,020. This region has 7 (Automotive, Food Processing and Manufacturing, Footwear, Jewelry and Precious Metals, Livestock Processing, Medical Devices, Textile Manufacturing) highly specialized clusters and 1 (Distributions and Ecommerce) strong regional cluster that is over 5% employment shares.

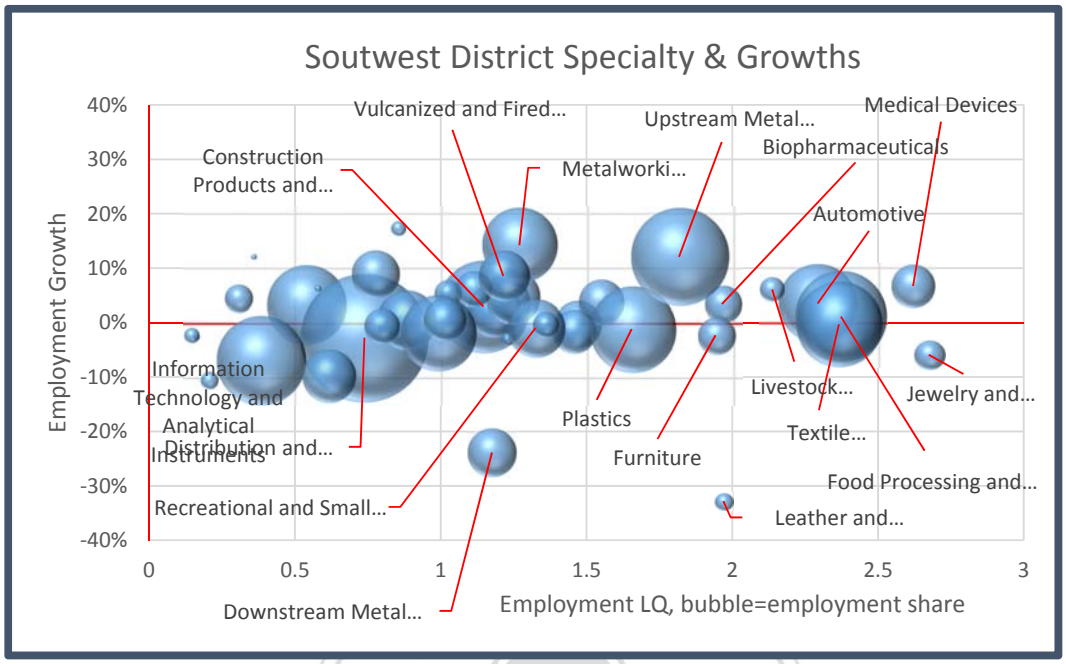
Figure 111 Southwest District Specialties.



Source: *Taiwan National Statistics Bureau*

The numbers of cluster's growth are high on revenue followed by employment and wages. Although the Distribution and Ecommerce is the largest cluster, but it is a bit less than the national level. There are three highly specialized clusters, Automotive, Textile Manufacturing, and Food Processing. Other specializations are Plastics, Recreational and Small Electric Goods, Metalworking Technology, Construction, Footwear, Medical Devices, Leather and Related Products, and Jewelry all contributing to the region.

Figure 112 Southwest District Specialties and Growths.



Source: *Taiwan National Statistics Bureau*

The Footwear category is an outlier since the category was added at 2011 Census, so as the Insurance Category. Three growing clusters over 10% growths are Upstream Metal Manufacturing, Metal Working Technology, and Vulcanized and Firing Materials, which are all national important. Other clusters remain small growths. The regional largest cluster of Distribution and Ecommerce is at a decline which can be alarming, and IT is also declining. This region does not adjacent to the high-tech region of the Northwest, therefore, do not receive the spillovers. This is also another proof for the spillovers is co-locational. Downstream Metal has at a steep declining rate which coincides with the board with other regions. We are also seeing the splitting for the upstream and downstream productions with the opposite growth rates.

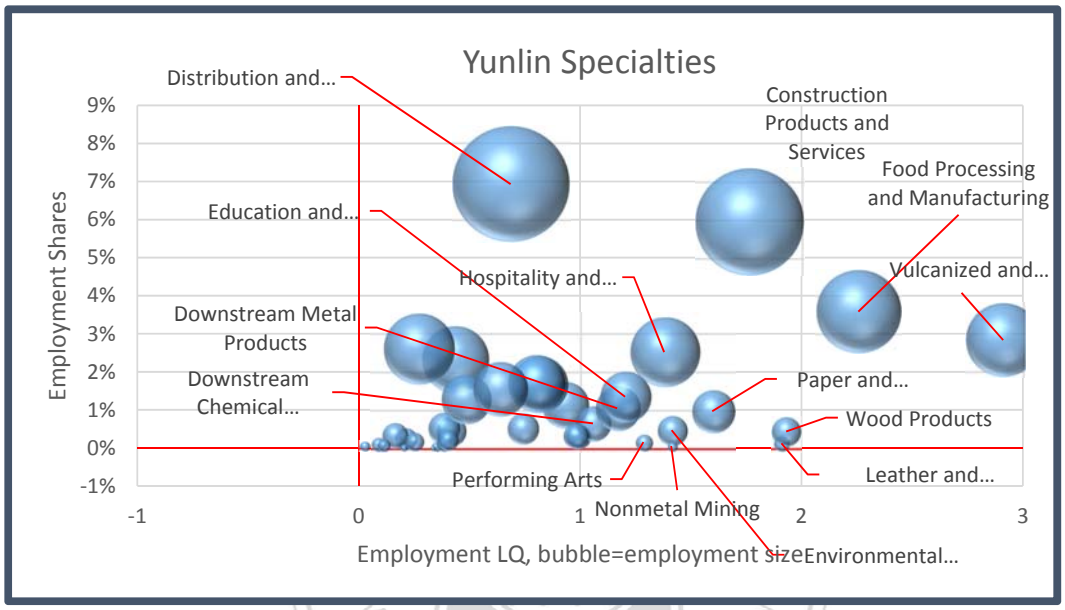
Below are the City analyses on all the Cities within the District.

Appendix 11.4.1. - Yunlin County

Yunlin has a population of 713,556 and a Cluster ID Score of 7,012,003,026,030,020. The City has 7 (Fishing and Fishing Products, Food Processing and Manufacturing,

Footwear, Livestock Processing, Textile Manufacturing, Upstream Chemical Products, Vulcanized and Fired Materials) highly specialized clusters, and 3 (Construction Products and Services, Distribution and Ecommerce, Textile Manufacturing) large regional clusters with over 5% employment shares.

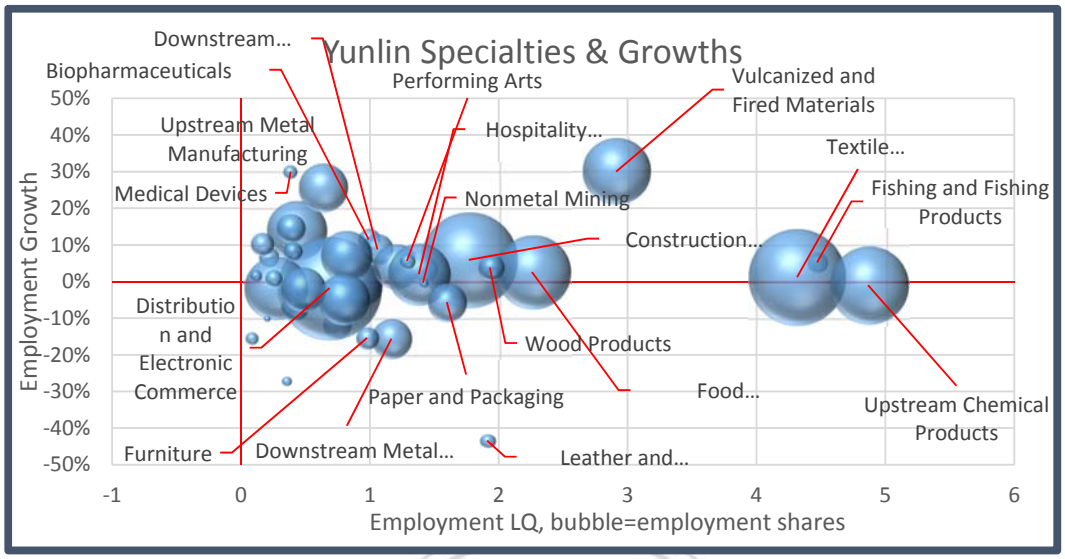
Figure 113 Yunlin Specialties.



Source: *Taiwan National Statistics Bureau*

The Construction Productions and Services cluster is regionally and nationally important. The Distribution and Ecommerce although is a strong cluster, it is not the main contributor of the national specialty. There are another 12 specializations which is also nationally significant which provide diversified clusters regionally. The Construction and Products and Services is a major specialty with 6% employment shares. The largest cluster is Distribution and Electronic Commerce which has 7% of employment shares. Two highly specialized clusters are Vulcanized and Fired Materials, and Food Production and Manufacturing. Other specialized clusters spread out in smaller shares of less than 3%.

Figure 114 Yunlin Specialties and Growth.



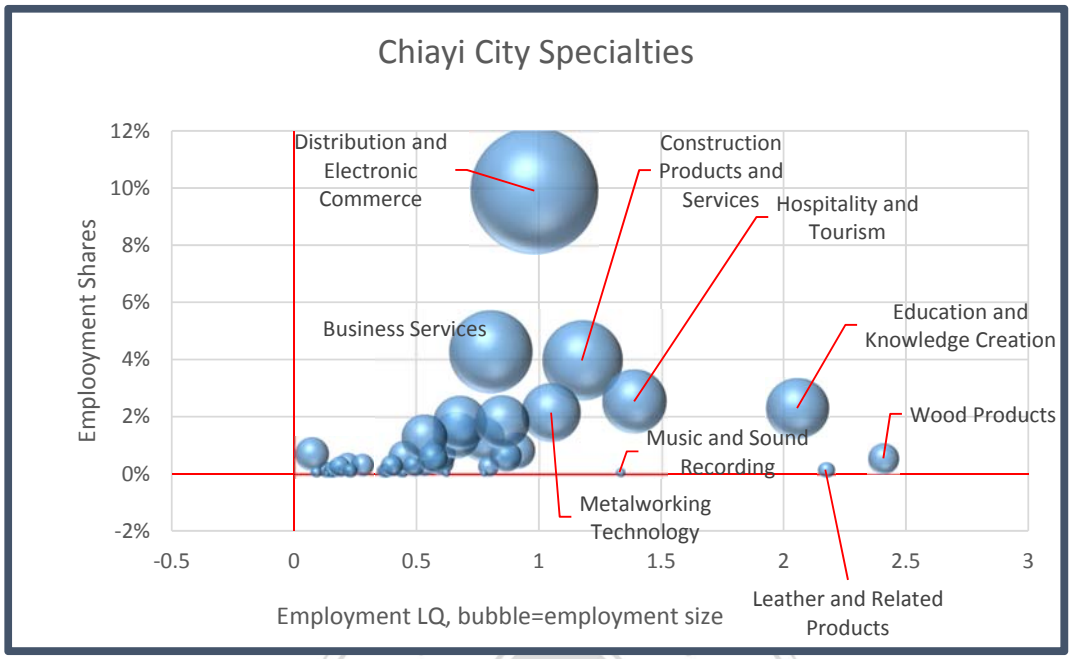
Source: *Taiwan National Statistics Bureau*

The number of clusters with revenue growth succeeds the employment and wage growths as commonly in most regions. The Vulcanized and Fired Materials is nationally important and on a high growth of 30%. The Construction Products and Services, and other specialties remain less than 10% growths. Upstream Metal Manufacturing, Medical Devices not in the national specialty but rising over 20%. Downstream Metal Manufacturing is on a sharp decline so as the Furniture which can be worrisome. This is a consistent decline across the whole cluster which is worth an investigation.

Appendix 11.4.2. - Chiayi City

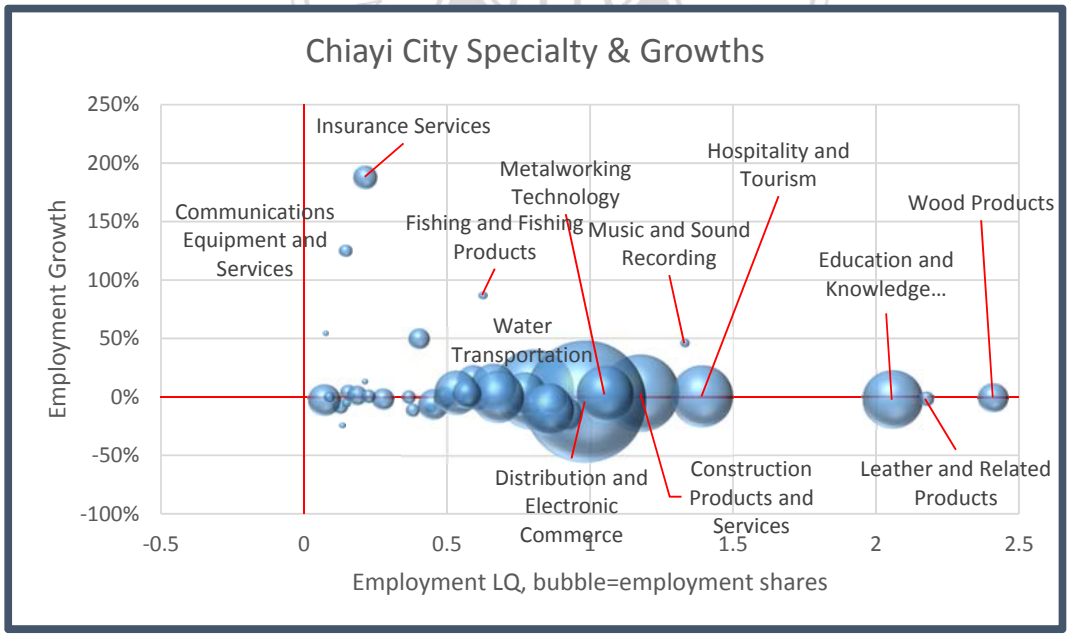
Chiayi City has a population of 271,526 and a Cluster ID Score of 3,004,001,020,029,020. It has 3 (Education and Knowledge Creation, Leather and Related Products, Wood Products) highly specialized clusters and 1 (Distribution and Electronic Commerce) largest cluster with over 5% employment shares. Other clusters spread out in the region with less than 5% shares.

Figure 115 Chiayi City Specialties.



Source: *Taiwan National Statistics Bureau*

Figure 116 Chiayi Specialties and Growths.



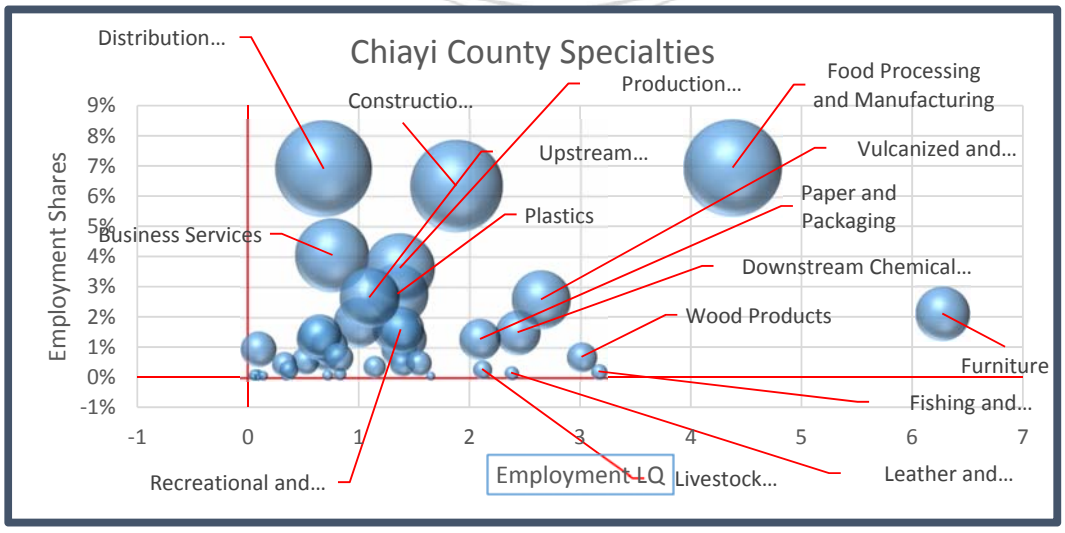
Source: *Taiwan National Statistics Bureau*

Chiayi has one dominated cluster, Distribution and Ecommerce, and 2 strong clusters of Business Services and Construction Products and Services. Hospitality is the next ranking. There are more clusters with revenue growths than employment and wage growths. The highly specialized clusters are Wood Products, Education and Knowledge Creation, and Leather and Related Products. Insurance Services and Communications Equipment and Services are on a high growth over 100%. Other growths are water related clusters. The Music and Sound Recording has a 50% growth rates on employment. Besides some very small clusters that are growing, all other specializations remain stable. The largest cluster Distribution and Electronic Commerce is at a small decline.

Appendix 11.4.3. - Chiayi County

Chiayi County has a population of 537,942 and a Cluster ID Score of 9,013,003,027,030,020. It has 9 (Downstream Chemical Products, Fishing and Fishing Products, Food Processing and Manufacturing, Furniture, Leather and Related Products, Livestock Processing, Paper and Packaging, Vulcanized and Fired Materials, Wood Products) highly specialized clusters and 3 (Construction Products and Services, Distribution and Electronic Commerce, Food Processing and Manufacturing) large regional clusters.

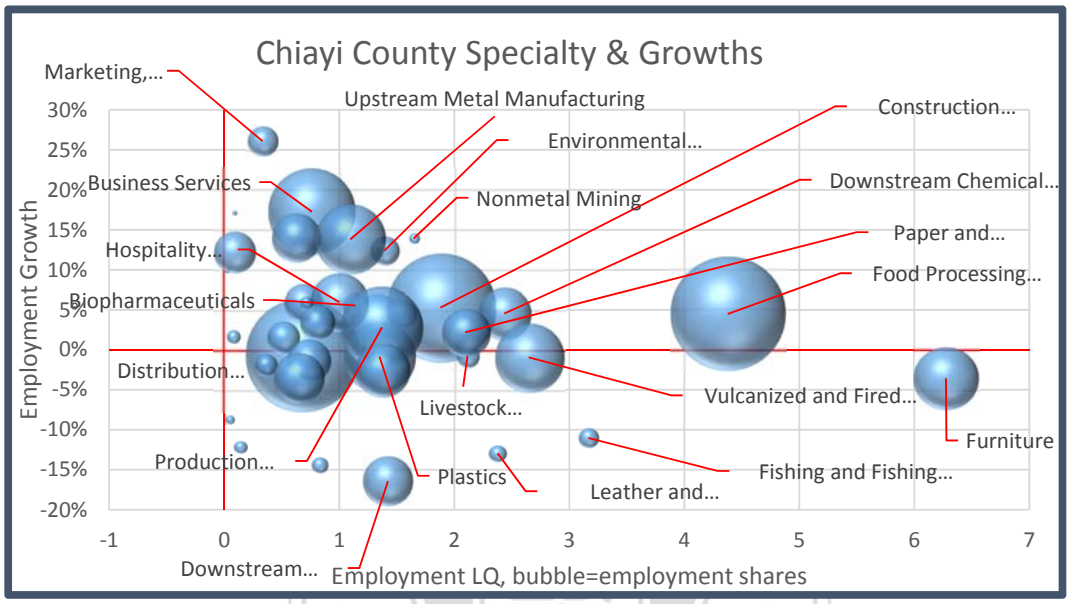
Figure 117 Chiayi County Specialties.



Source: *Taiwan National Statistics Bureau*

This City has three strong clusters, Food Processing, Construction, and Distribution and Ecommerce. Chiayi also highly specializes in Furniture.

Figure 118 Chiayi County Specialties and Growths.



Source: *Taiwan National Statistics Bureau*

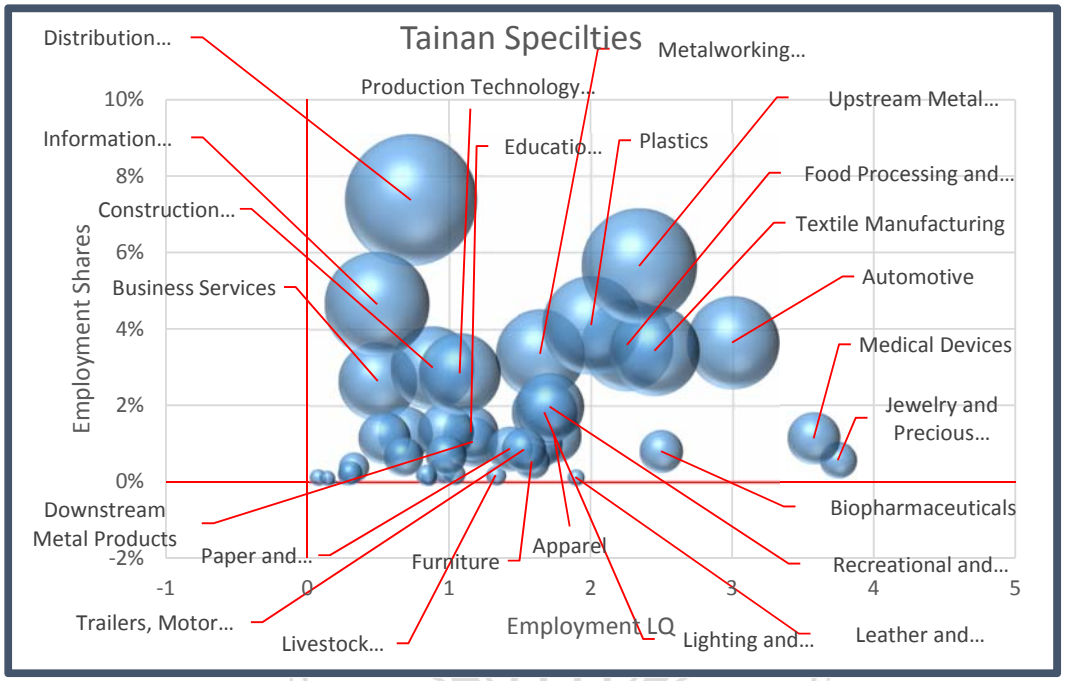
Food Processing and Manufacturing is a growing regionally and nationally specialized cluster with 5% growths. Upstream Metal Manufacturing, Nonmetal Mining, and Environmental Services are growing over 10% in the specialization clusters. Downstream Chemical Products, Construction, Production Technology, and Environment Services are all growing specializations about 5%. Marketing and Business Services are on the high growth although not yet in the national significant ratio. Among the declining cluster, the Downstream Metal Products made the worst declines of over 15%, and the Fishing and Fishing Products is decline over 10%.

Appendix 11.4.4. - Tainan City

Tainan City has a population of 1,876,960 and a Cluster ID Score of 8,014,002,024,029,020. It has 8 (Automotive, Biopharmaceuticals, Food Processing and Manufacturing, Jewelry and Precious Metals, Medical Devices, Plastics, Textile Manufacturing, Upstream Metal Manufacturing) highly specialized clusters, and 2

(Distribution and Ecommerce, Upstream Metal Manufacturing) large regional clusters that are 5% or more employment shares.

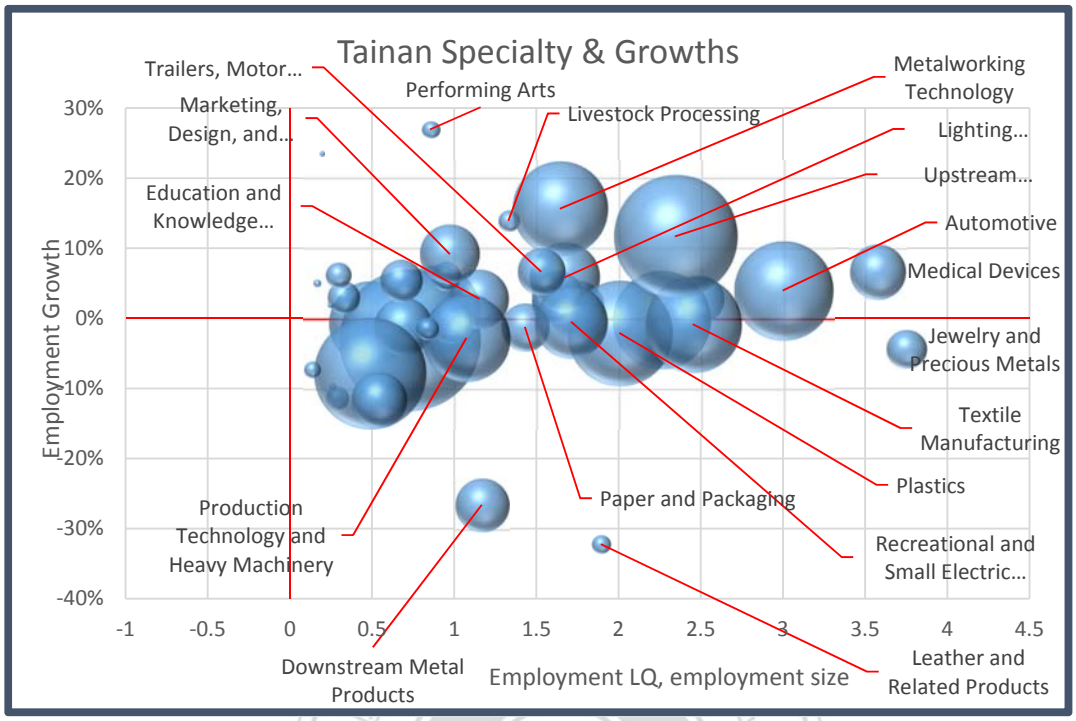
Figure 119 Tainan Specialties.



Source: *Taiwan National Statistics Bureau*

The Upstream Metal Manufacturing cluster specialization is important regionally and nationally with a 5% employment participations. Other manufacturing specialization spread out the 4% shares clusters and are high specialized as well. The very highly specialized clusters are Medical Devices, Jewelry and Precious Metals, Automotive, Biopharmaceuticals, Textile Manufacturing, and Food Processing. The Distribution and Electronic Commerce yet is the largest cluster, but not yet a national specialization.

Figure 120 Taiwan Specialties and Growths.



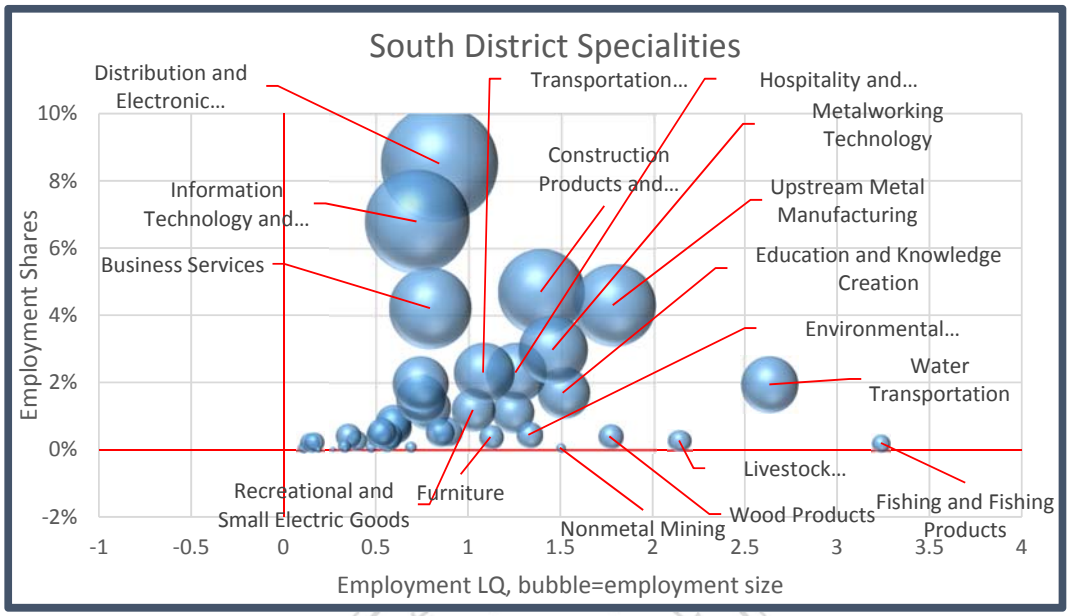
Source: *Taiwan National Statistics Bureau*

Metal Working Technology, Upstream Metal Manufacturing are two highest growing specialties with over 10% growth rates, and Leather and Related Products is the worst decline cluster with over 30% decline rates, and Downstream Metal Product cluster is also on a sharp decline with over 25% decline rates. Textile Manufacturing, Recreational and Small Electric Goods, Paper and Packaging, and Production Technology and Heavy Machinery are all at a small decline less than 5%. Among others specialization not mentioned, they are growing with less than 10% growth rates.

South – Kao-Ping District

South District has a population of 3,638,999 and a Cluster ID Score of 3,012,002,022,031,020. It has 3 (Fishing and Fishing Products, Livestock Processing, Water Transportation) highly specialized clusters and 2 (Distribution and Ecommerce, Information Technology and Analytical Instruments) large regional clusters with over 5% employment shares. The most numbers of growths are revenue growths then employment and wages growths respectively.

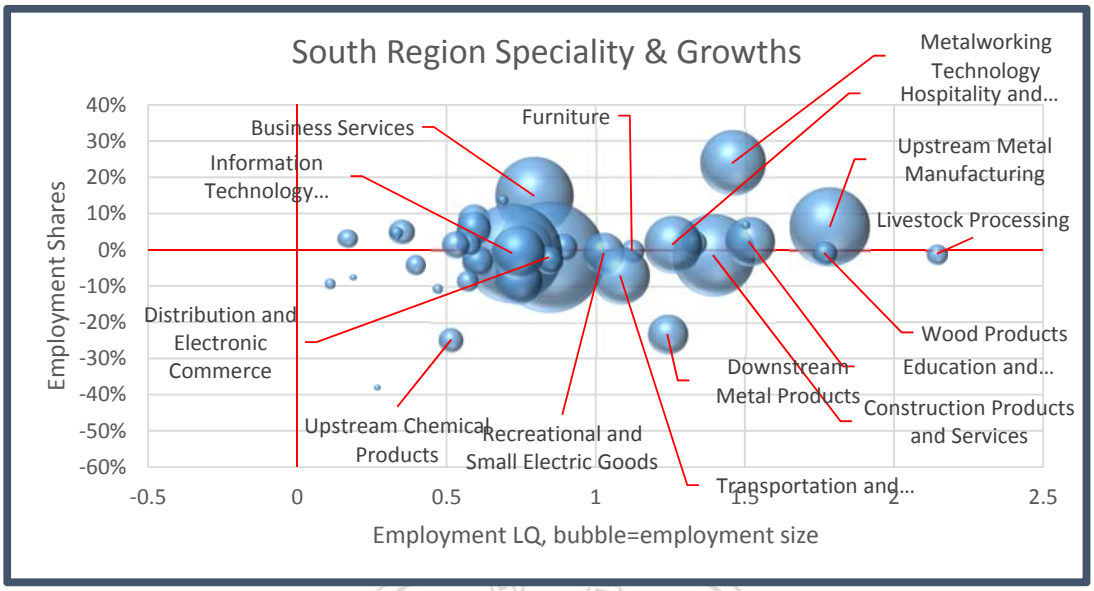
Figure 121 South District Specialties.



Source: *Taiwan National Statistics Bureau*

This region is in the south tip of Taiwan has a major port in one of the Cities; therefore, this is a region more focusing on water businesses and farming as the national specialties. This region has many more clusters growing in revenue than employment and wage growths. It is interesting to see that the three largest clusters are not those of national specializations.

Figure 122 South District Specialties and Growths



Source: *Taiwan National Statistics Bureau*

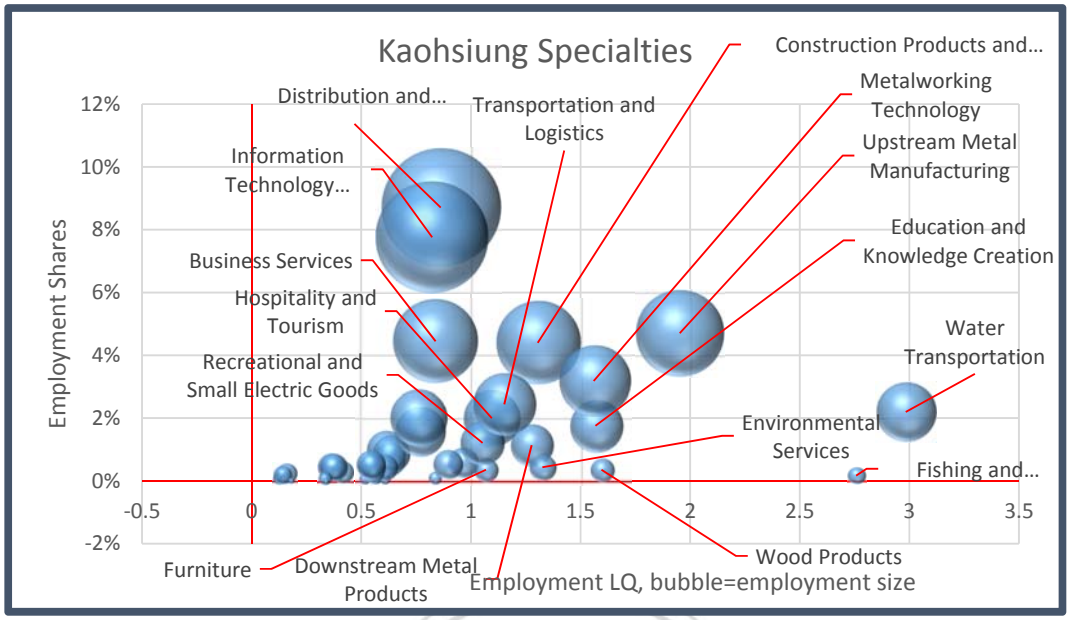
Metalworking Technology and Upstream Metal Manufacturing are the faster growing and specialized clusters, and Downstream Metal Products is the declining cluster with over 20% rates. The Business cluster is a rising cluster with a growth rate over 10% although not in the national specialty ratio yet. The Upstream Chemical is at a steep decline over 20%.

The following is the Cities in the District.

Appendix 11.5.1. - Kaohsiung City

Kaohsiung has a population of 2,774,470 and a Cluster ID Score of 2,011,002,024,029,020. It has 2 (Fishing and Fishing Products, Water Transportation) highly specialized clusters and 2 (Distribution and Electronic Commerce, Information Technology and Analytical Instruments) larger regional clusters over 5% employment shares. More number of clusters in revenue growth than employment and wages.

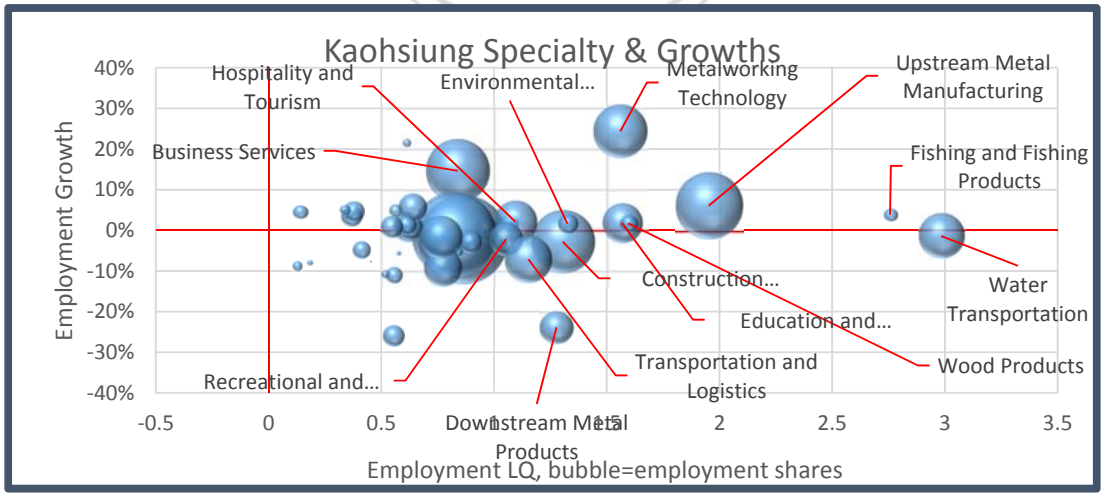
Figure 123 Kaohsiung Specialties.



Source: *Taiwan National Statistics Bureau*

Fishing and Fishing Products, and Water Transportation are highly specialized clusters. The 2 largest clusters are not in the national specializations, and they are Distribution and Electronic Commerce, and Information Technology and Analytical Instruments. Metalworking Technology and Upstream Metal Manufacturing, and Business Services are all strong clusters in the region.

Figure 124 Kaohsiung Specialties and Growths.



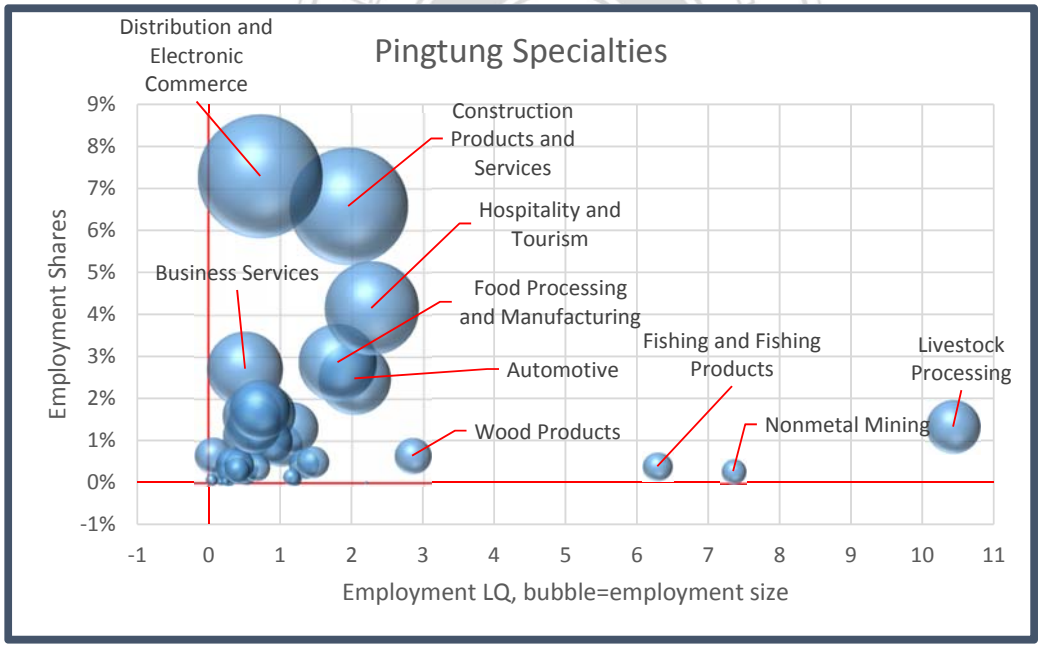
Source: *Taiwan National Statistics Bureau*

Metalworking Technology is growing over 20%, and Upstream Metal Manufacturing is growing over 5%. Fishing and Fishing Products is growing around 5%, but Water Transportation is declining. One of fast growing clusters in most Cities is the Business Services at about 15% rates. Downstream Metal Products is declining over 20%, and this is quite consistent with other Cities too. Transportation and Logistics and Construction Products and Services are all declining below 10% rates.

Appendix 11.5.2. - Pingtung County

Pingtung County has a population of 864,529 and a Cluster ID Score of 7,008,002,029,032,030. It has 7 (Automotive, Fishing and Fishing Products, Hospitality and Tourism, Livestock Processing, Metal Mining, Nonmetal Mining, Wood Products) highly specialized clusters and 2 (Construction Products and Services, Distribution and Electronic Commerce) large clusters that are over 5% employment shares.

Figure 125 Pingtung Specialties.

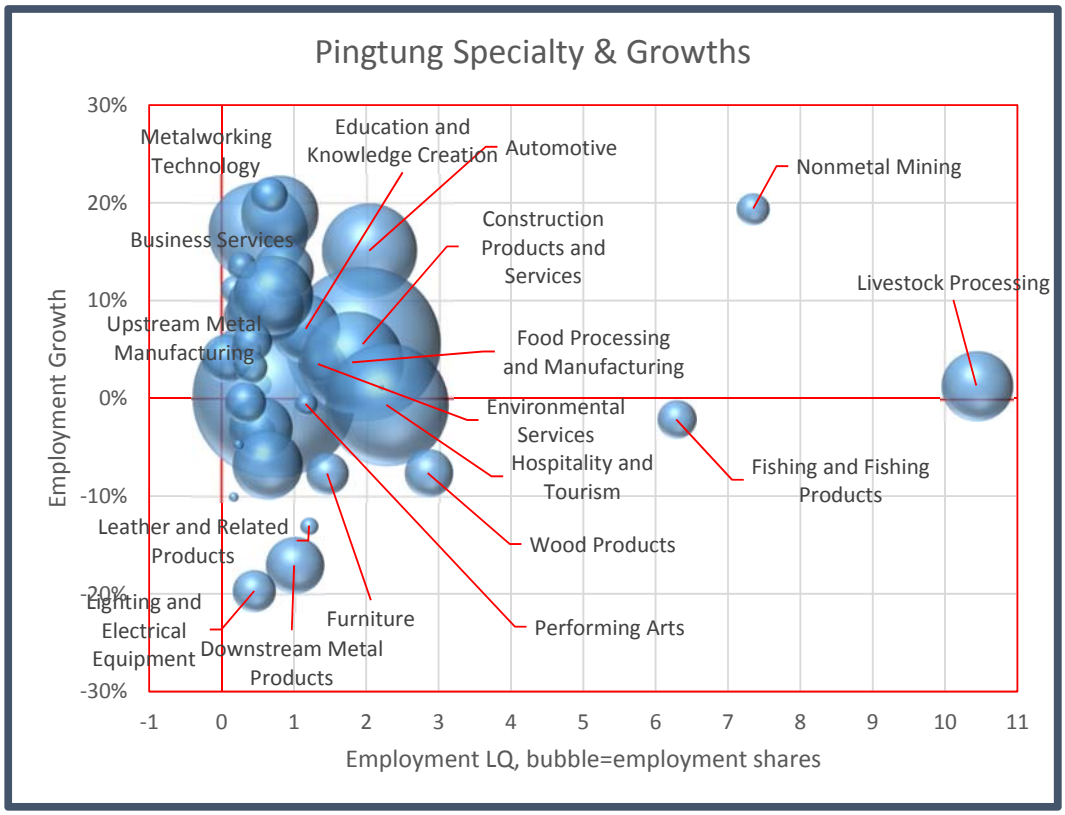


Source: *Taiwan National Statistics Bureau*

Pingtung at the south tip of Taiwan has tropical weather climate with nice ocean shoreline is a famous tourist attraction. The clusters are developed based on its

endowment and the local lifestyle. There are some highly specialized clusters that fits the local lives such as Livestock Processing, Nonmetal Mining, Fishing and Fishing Products, and Wood Products. The bigger specialized clusters are Construction Products and Services and Hospitality and Tourism. The largest cluster is Distribution and Electronic Commerce at almost a national specialty.

Figure 126 Pingtung Specialties and Growths.



Source: *Taiwan National Statistics Bureau*

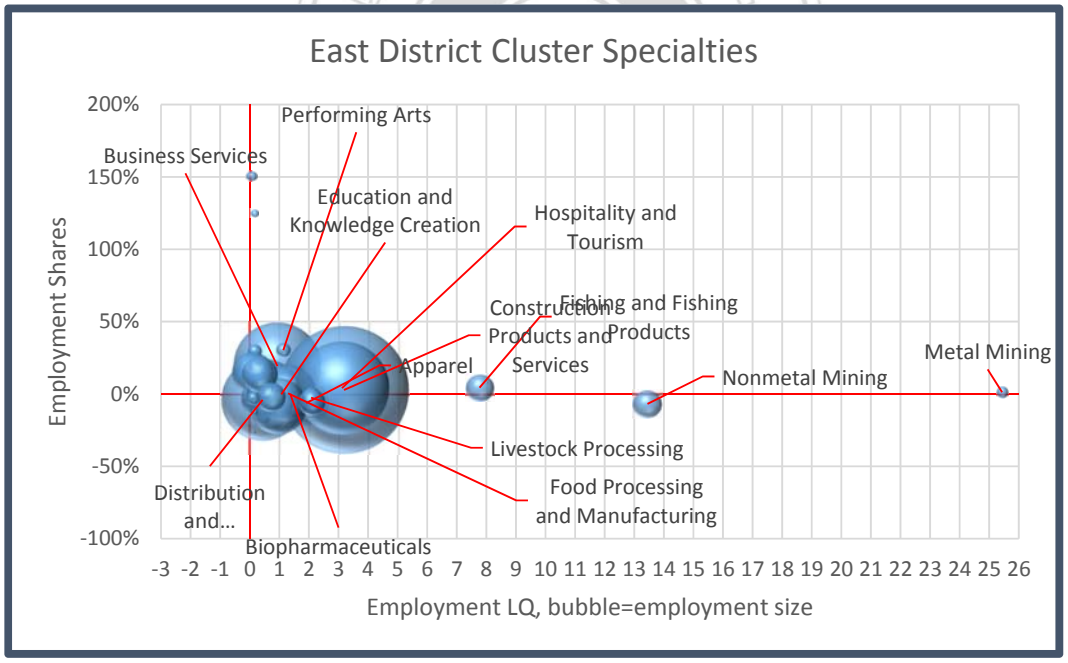
Revenue, wage and employment growths are high in this region, the numbers of clusters of wage growths are faster than the employment for a surprise. It is an indication the labor shortage in some areas. A close look at the growing cluster can give some indications on the labor and skill demands. Among highly specialized clusters Nonmetal Mining, Automotive, Construction Products and Services, Food Processing and Manufacturing, and Livestock Processing are growing, Fishing and Fishing Products, Wood Products, and Hospitality and Tourism Services are declining. Furniture,

Performing Arts, and Leather and Related Products are declining among in the specialized clusters. There are some regionally rising clusters such as Education and Knowledge Creation, Metalworking Technology, Business Services, and Upstream Metal Manufacturing.

East District – Yilan, Hualien, Taitung

East Region has a population of 1,024,189 and a Cluster ID Score of 7,005,002,023,031,020. It has 7 (Construction Products and Services, Fishing and Fishing Products, Hospitality and Tourism, Livestock Processing, Metal Mining, Nonmetal Mining, Wood Products) clusters are highly specialized and 2 (Construction Products and Services, Hospitality and Tourism) large regional clusters with over 5% employment shares. These 2 larger clusters correspond to the highly specialized national clusters. More clusters are with revenue growth than employment and wages respectively.

Figure 127 East District Specialties.

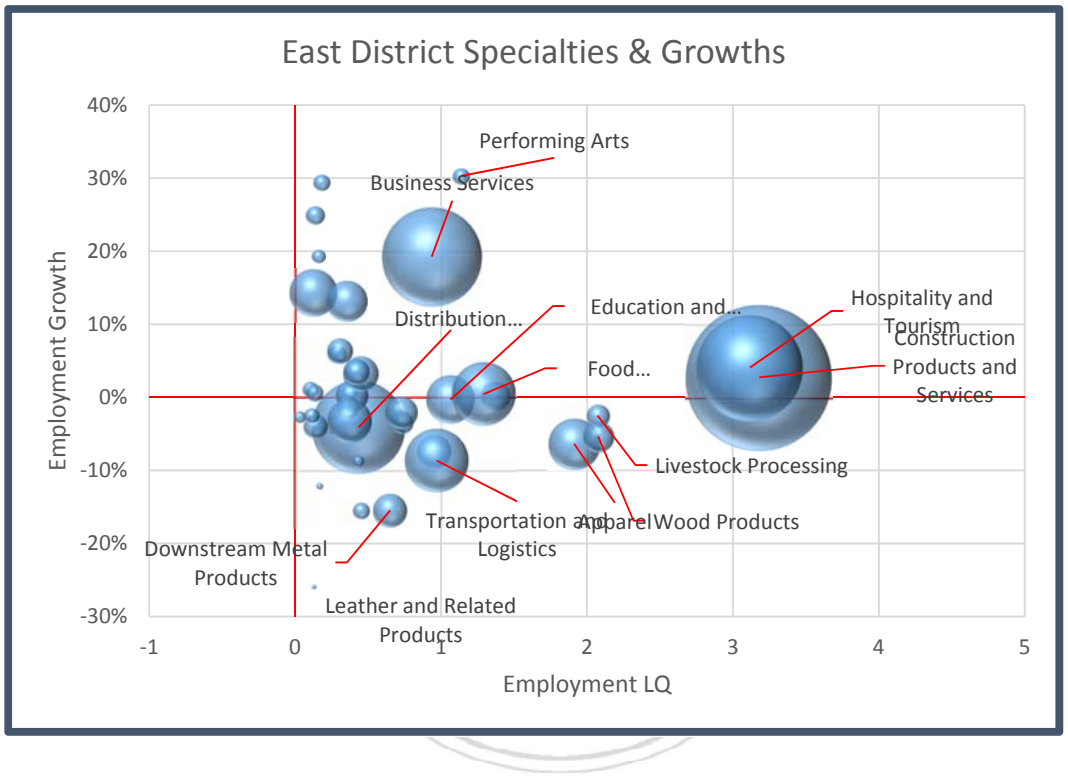


Source: *Taiwan National Statistics Bureau*

The East district is a smaller region. The transportation is not as convenient. The east coast has a long shoreline facing the Pacific Ocean, water activities are one of the main

lifestyles. The high drop of cliff side gives beautiful scenic views. The long drop central mountains hide some treasonous marbles and jade. The highly specialized clusters such as Metal Mining, Nonmetal Mining, Fishing and Fishing Products, Hospitality and Tourism, and Construction Products and Services are natural development of the local endowments.

Figure 128 East District Specialties and Growths.



Source: *Taiwan National Statistics Bureau*

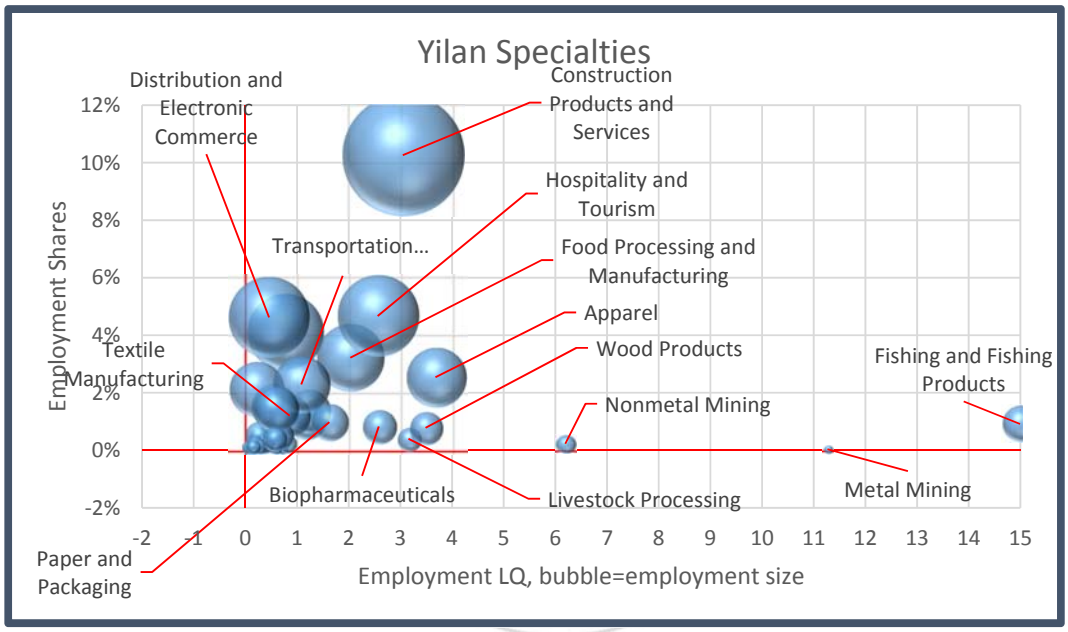
Performing Arts is on the highest growths. Business Services is on the rise as other regions do. Hospitality and Tourism, Construction Products and Services, Food Processing are on small growths within the national specializations. The worst decline is the Downstream Metal Products with over 15% rates. Apparel, Wood Products, Livestock Processing, Transportation and Logistics and Distribution and Ecommerce are not doing so well either.

The East Region has Yilan County, Hualien County, and Taitung County. Below are close analyses of these counties.

Appendix 11.6.1. - Yilan County

Yilan has a population of 459,061 and a Cluster ID Score of 10,004,001,024,029,000. With 10 (Apparel, Biopharmaceuticals, Construction Products and Services, Fishing and Fishing Products, Food Processing and Manufacturing, Hospitality and Tourism, Livestock Processing, Metal Mining, Nonmetal Mining, Wood Products) highly specialized clusters and 1 (Construction Products and Services) large cluster over 5% employment shares.

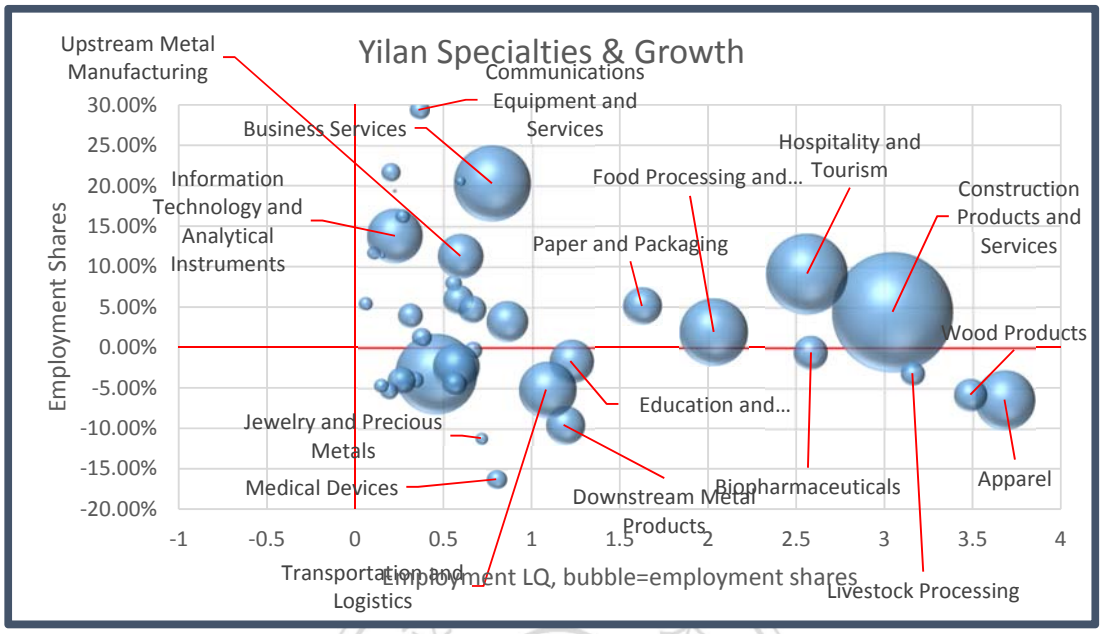
Figure 129 Yilan Specialties.



Source: *Taiwan National Statistics Bureau*

The Construction Products and Services cluster is the dominate specialization in this region. All other clusters are smaller and diversified. More clusters are on revenue and employment growths, but no wage growths.

Figure 130 Yilan Specialties and Growths.



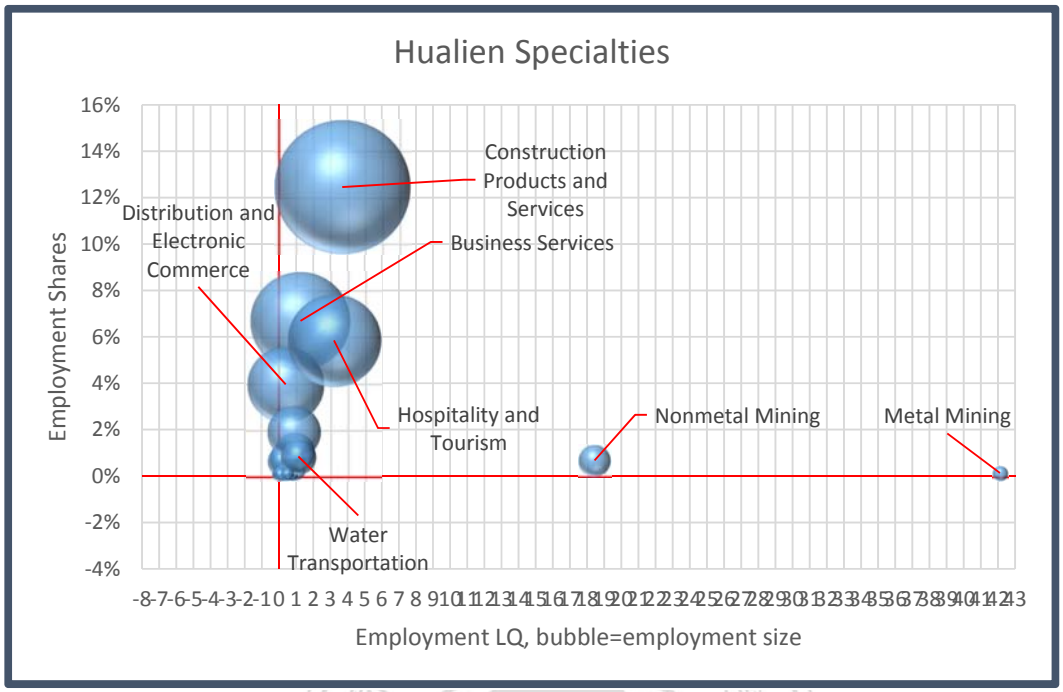
Source: *Taiwan National Statistics Bureau*

Construction Products and Services, Paper Packaging, and Hospitality and Tourism clusters are on higher growth specializations, but there are many declining clusters such as Apparel, Wood products, Biopharmaceuticals, Education, Medical Devices, Transportation and Logistics, and Downstream Metal Products. Business Services IT, and Upstream Metal Manufacturing clusters are on the rise.

Appendix 11.6.2. - Hualien County

Hualien County has a population of 336,838 and a Cluster ID Score of 4,002,003,024,026,020. It has 4 (Construction Products and Services, Hospitality and Tourism, Metal Mining, Nonmetal Mining) highly specialized clusters and 3 (Business Services, Construction Products and Services, Hospitality and Tourism) large regional clusters with over 5% employment shares.

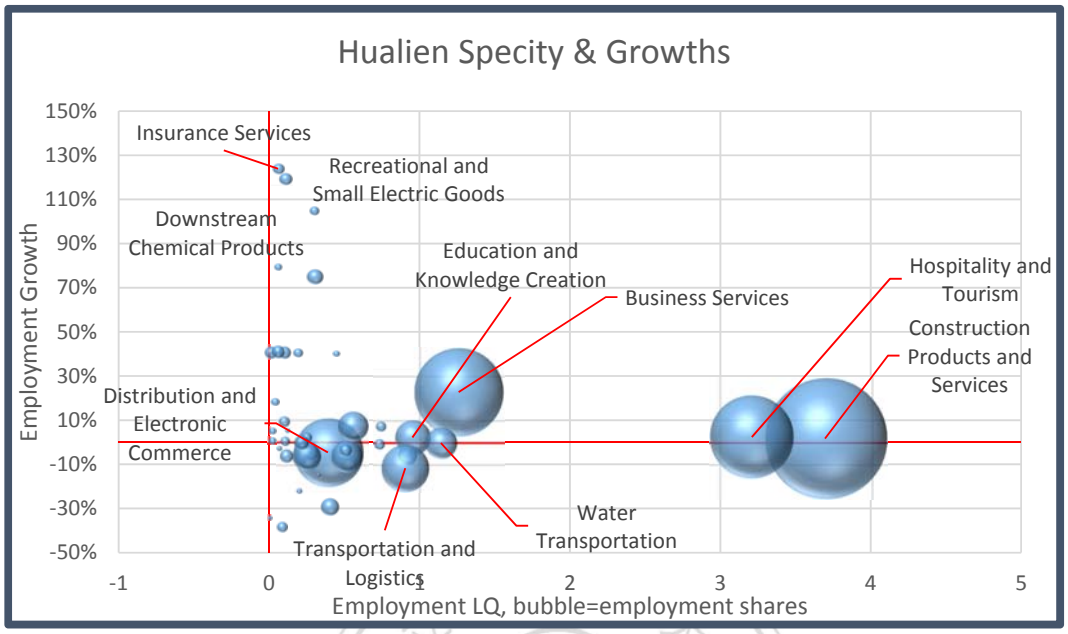
Figure 131 Hualien Specialties.



Source: *Taiwan National Statistics Bureau*

Hualien has a small population. It is famous for Taiwan Jade and marbles. It is also a community of for Taiwan indigenous living. Construction cluster by employment shares is a dominate cluster also at national specialization. The Metal and Nonmetal Mining are extremely specialized in Hualien. Hospitality is a major cluster for the City. Business Services and Water Transportation are also specialized clusters.

Figure 132 Hualien Specialties and Growths.



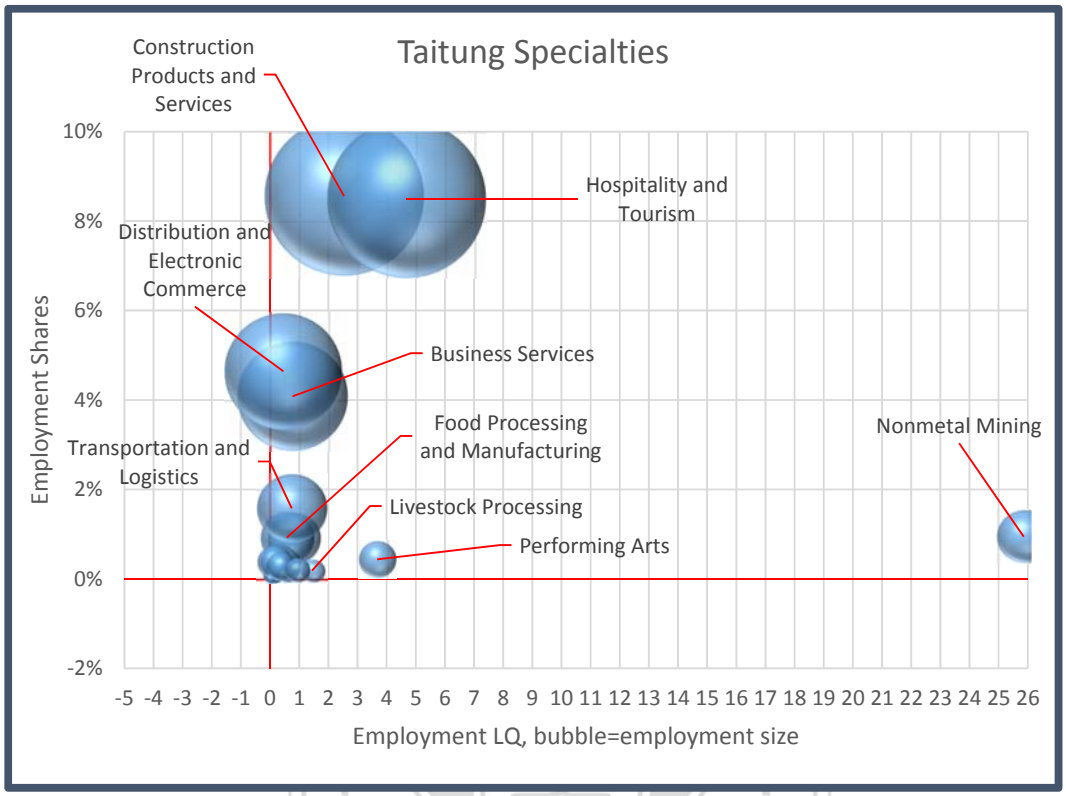
Source: *Taiwan National Statistics Bureau*

Business Services cluster is growing as one of the larger specialized clusters with an over 20% rates, and Transportation Logistics is declining but not a national specialty. The other higher growing clusters such as Insurance Services, Recreation and Small Electric Goods, Downstream Chemicals are growing in high rates but very small at presence.

Appendix 11.6.3. - Taitung County

Taitung County has a poulation of 228,290 and Cluster ID Score of 5,001,002,014,021,010. It has 5 (Construction Products and Services, Hospitality and Tourism, Metal Mining, Nonmetal Mining, Performing Arts) highly specialized clusters, and 2 (Construction Products and Services, Hospitality and Tourism) large regional clusters over 5% employment shares.

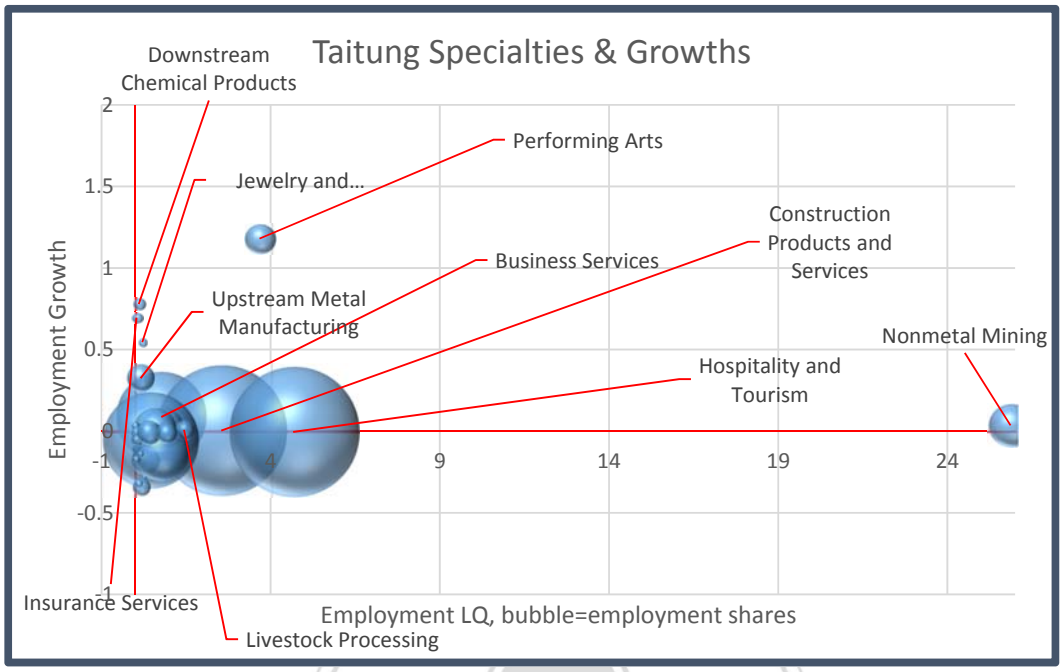
Figure 133 Taitung Specialties.



Source: *Taiwan National Statistics Bureau*

This is a small City, the furthest away from the big metropolitans. Many surfers come to Taitung for the good waves. It is also famous for its tranquility and scenic sights. Business Services and Distribution and Electronic Commerce almost made the national specialization concentrations. Nonmetal Mining being the very specialized cluster in this region and so as the Performing Arts. The two strong specializations are Construction Products and Services, and Hospitality and Tourism.

Figure 134 Taitung Specialties and Growths.



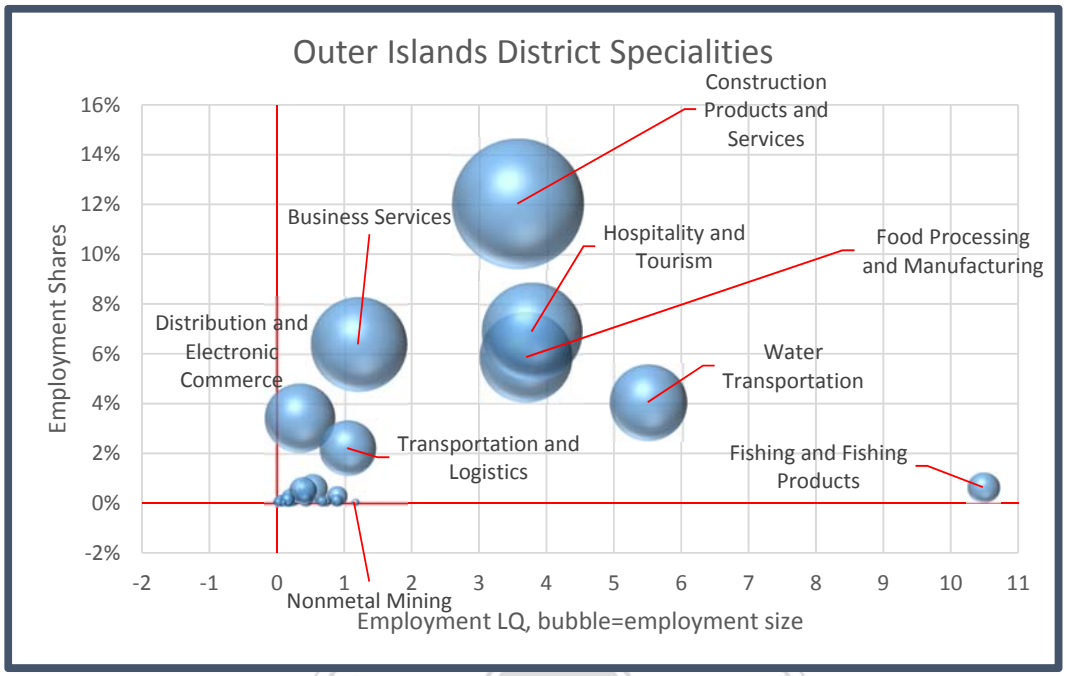
Source: *Taiwan National Statistics Bureau*

The highest growth cluster is Performing Arts, and other higher growths are all smaller clusters such as Downstream Chemical Products, Jewelry, Performing Arts, and Upstream Metal Manufacturing. The remaining clusters are stable.

Outer Islands District

The Outer Islands District has a population of 211,146 and a Cluster ID Score of 6,003,004,025,026,020. It has 6 (Aerospace Vehicles and Defense, Construction Products and Services, Fishing and Fishing Products, Food Processing and Manufacturing, Hospitality and Tourism, Water Transportation) highly specialized clusters and 3 (Business Services, Construction Products and Services, Food Processing and Manufacturing) large regional clusters that are over 5% employment shares.

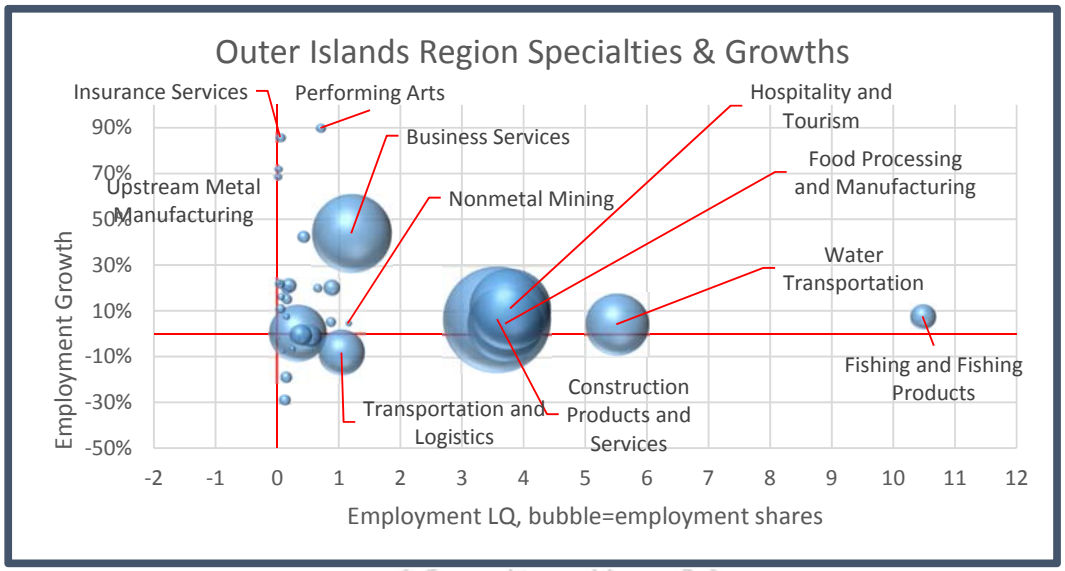
Figure 135 Outer Islands District Specialties.



Source: *Taiwan National Statistics Bureau*

The outer islands are many small islands mostly with military stations. Transportations to outside is limited, but after ECFA signed, many Chinese come through islands to tour; therefore, the tourism has been up. The island life surrounds the water activities. Fishing and Water Transportation Food Processing, Tourism are all highly specialized in this region. Business Services, Transportation Services, and Metal Mining are specializations. Revenue and employment growths are about the same and followed by the wage growths. The Construction Products and Services dominates the region.

Figure 136 Outer Islands District Specialties and Growths.



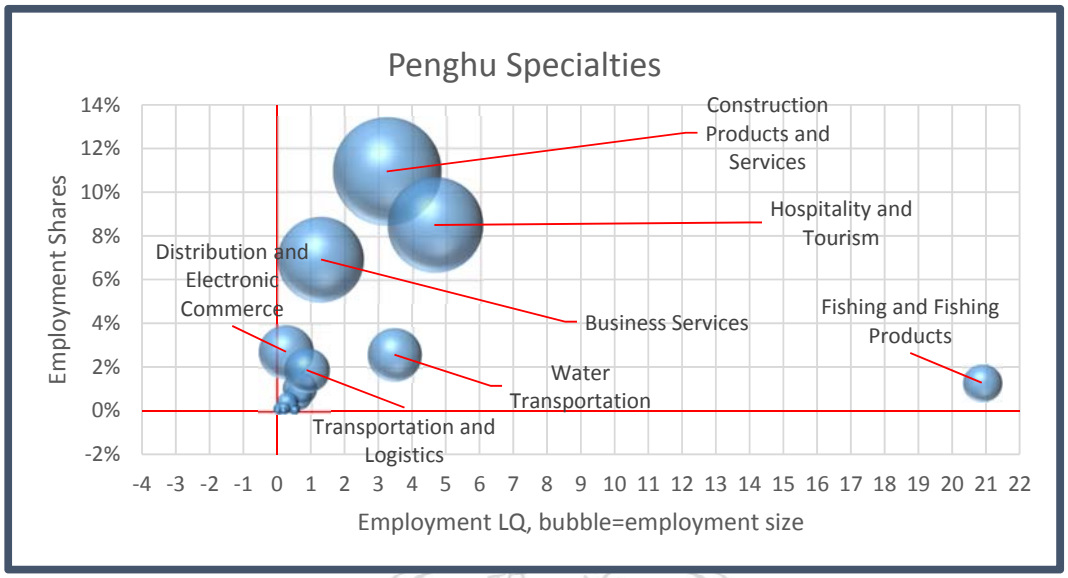
Source: *Taiwan National Statistics Bureau*

This is a limited accessed region with military presence. Life there tends to be isolated and stable; therefore, the clusters reflect the environment. The growths on clusters are very stable except the Business and Services cluster and some smaller clusters such as Performing Arts, Insurance, Upstream Metal Manufacturing, and Business Services. One of significant clusters is declining, and that is the Transportation and Logistics cluster. The Cities for this district are Penghu, Kinmen, and Lienchiang.

Appendix 11.7.1. - Penghu County

Penghu County has a population of 97,157 and a Cluster ID Score of 4,001,003,017,015,000. It has 4 (Construction Products and Services, Fishing and Fishing Products, Hospitality and Tourism, Water Transportation) highly specialized clusters, and 3 (Business Services, Construction Products and Services, Hospitality and Tourism) large regional clusters with over 5% employment shares. The growth rate is different from other regions that employment growth is higher than the revenue, and there is no wage growth.

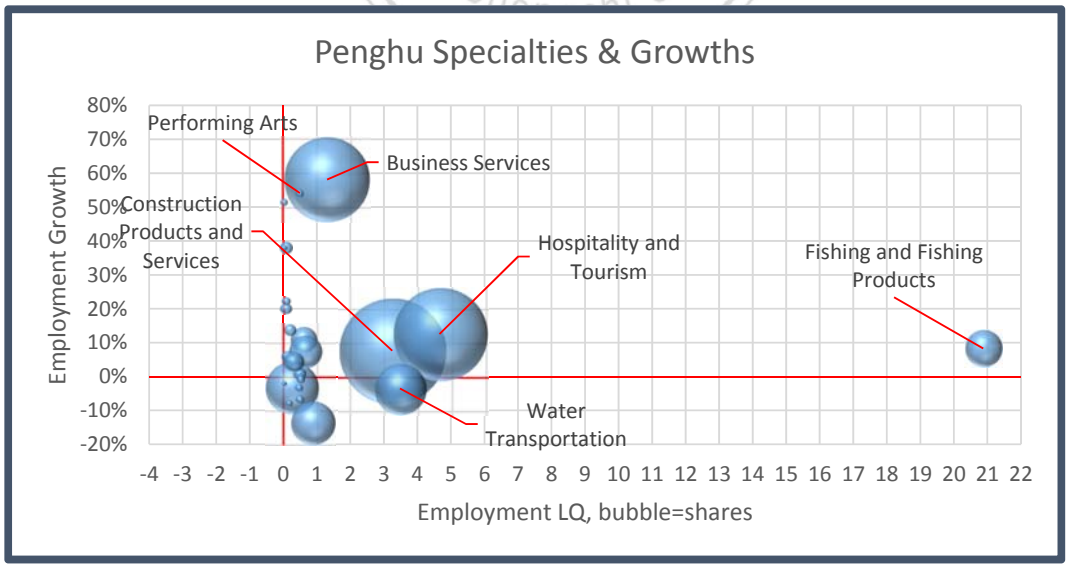
Figure 137 Penghu Specialties.



Source: *Taiwan National Statistics Bureau*

These islands are isolated and small. Not all clusters are presented in the islands, so that most clusters are very specialized for islands' need. Aerospace cluster is new and for the purpose of defense development, but recently it has gone international and commercial; therefore, the growth rate is very high since it starts from zero.

Figure 138 Penghu Specialties and Growths.



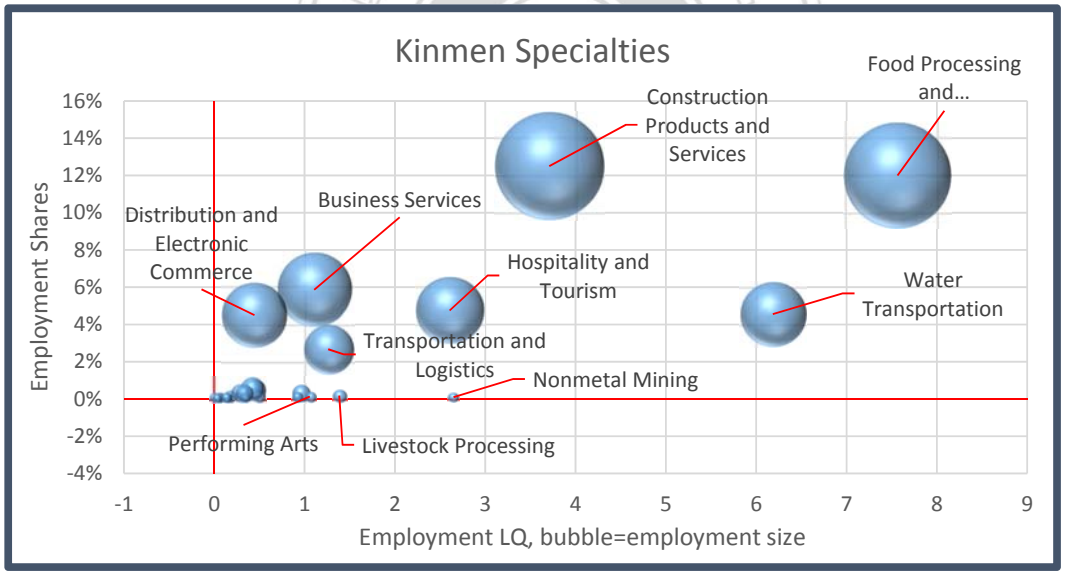
Source: *Taiwan National Statistics Bureau*

The Business Services cluster has a big growth, over 55%, followed by the Hospitality, Fish and Fishing Products, and Construction Products and Services clusters' growths around 10%. Other high growths are smaller clusters such as Performing Arts, over 50%. Water transportation is a declining specialization.

Appendix 11.7.2. - Kinmen County

Kinmen County has a population of 103,883 and a Cluster ID Score of 6,004,003,022,022,020. It has 6 (Aerospace Vehicles and Defense, Construction Products and Services, Food Processing and Manufacturing, Hospitality and Tourism, Nonmetal Mining, Water Transportation) highly specialized clusters and 3 (Aerospace Vehicles and Defense, Construction Products and Services, Food Processing and Manufacturing) large regional clusters that are over 5% of employment shares. The Food Processing and Construction Products and Services are two leading clusters in the region.

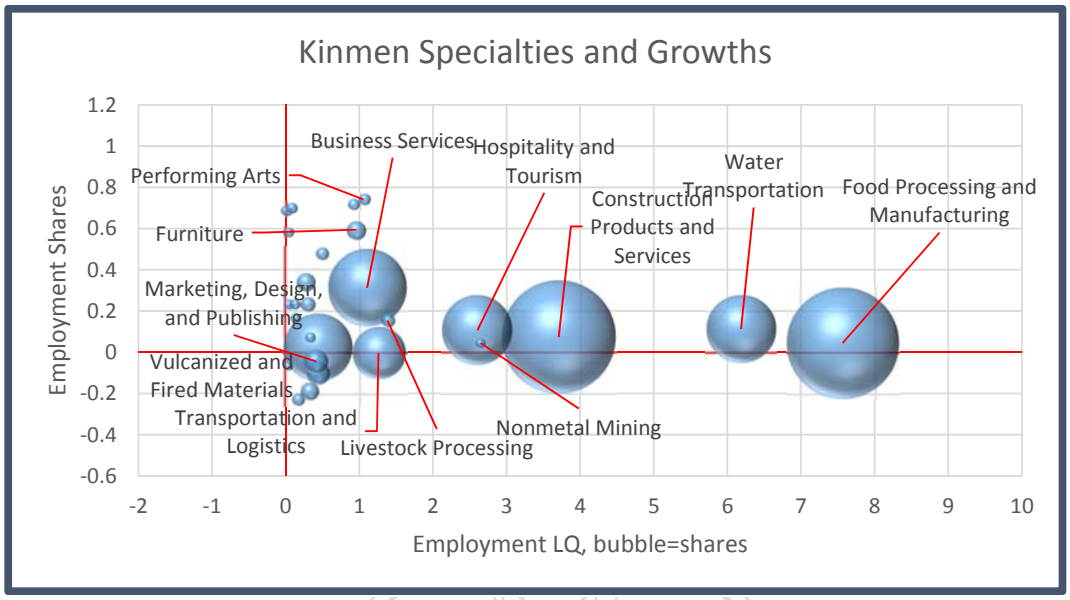
Figure 139 Kinmen Specialties.



Source: *Taiwan National Statistics Bureau*

Construction Products and Services, and Food Processing dominate the City. Water Transportation and Hospitalization are the bigger specializations in the City.

Figure 140 Kinmen Specialties and Growths.



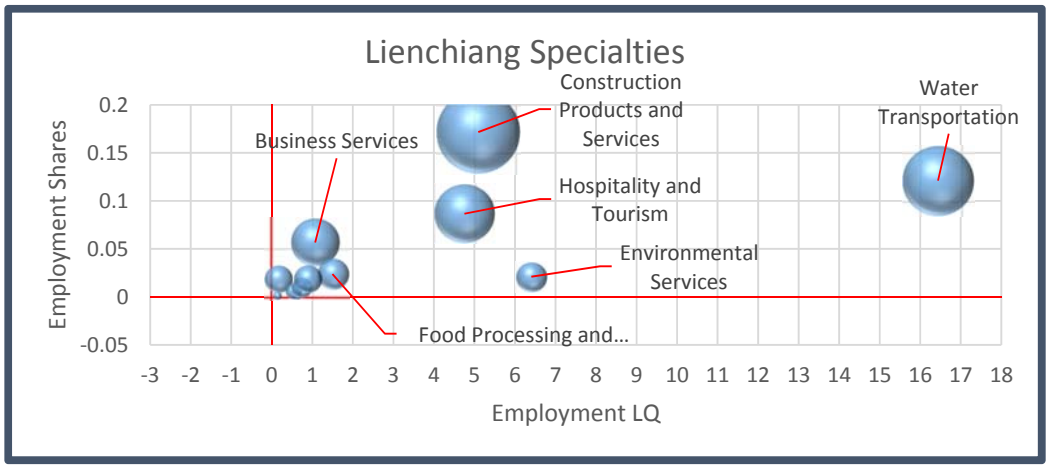
Source: *Taiwan National Statistics Bureau*

The clusters on the island are stable with some very small clusters' growing such as Performing Arts with an over 5% growth rates. The declining clusters are also very small such as Marketing and Design, and Furniture clusters. Business Services is growing strongly here.

Appendix 11.7.3. - Lienchiang County

Lienchiang County has a population of 10,106 and a Cluster ID Score of 4,002,004,007,007,010. It has 4 (Construction Products and Services, Environmental Services, Hospitality and Tourism, Water Transportation) highly specialized clusters and 4 (Business Services, Construction Products and Services, Hospitality and Tourism, Water Transportation) large regional clusters that are over 5% employment Shares.

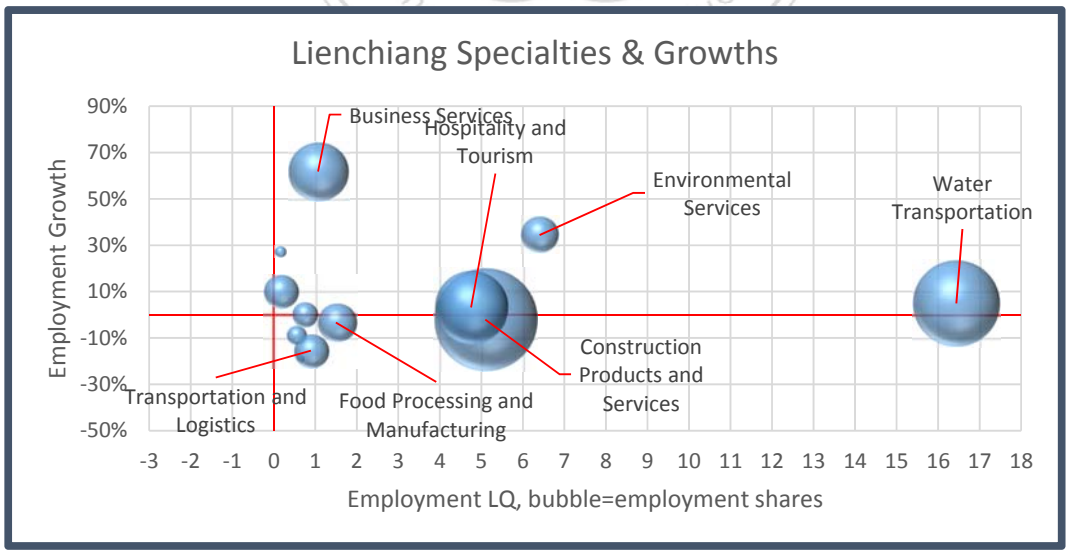
Figure 141 Lienchiang Specialties.



Source: *Taiwan National Statistics Bureau*

This is a very small island with only about ten thousand people. Not all clusters are presented. Water transportation, and Construction Products and Services dominates the island and highly specialized clusters. The island is very close to China. Resources on the island is very limited. It depends on Taiwan's mainland's support. Life here will probably not change much.

Figure 142 Lienchiang Specialties and Growths.



Source: *Taiwan National Statistics Bureau*

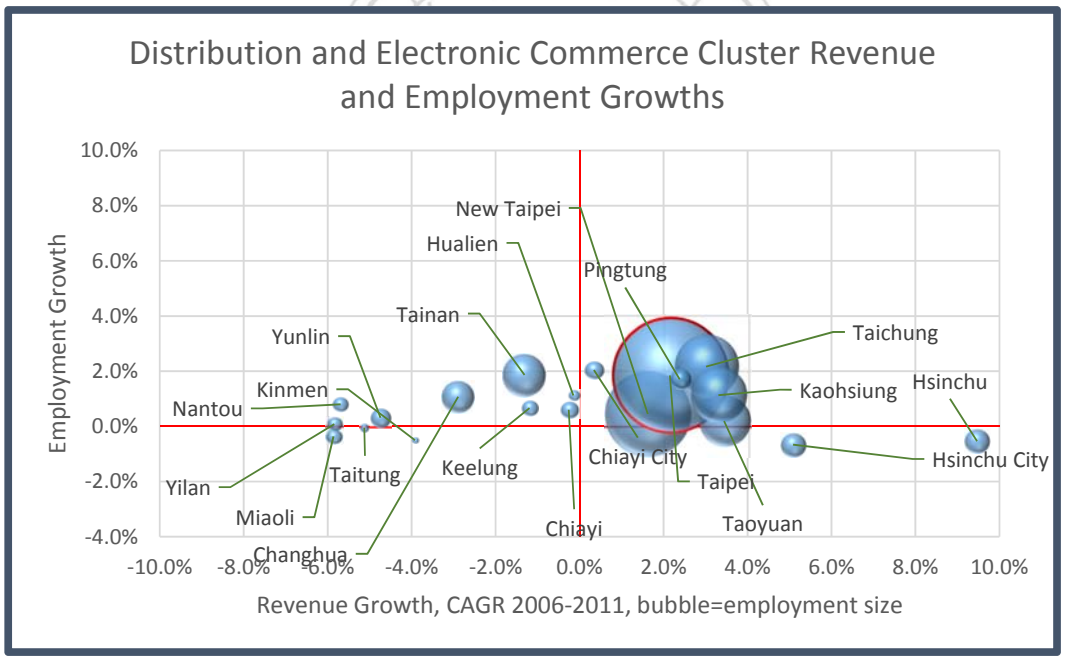
The Business Services is on high growth at about 60%. The second highest growing cluster is the Environmental Services, also highly specialized. Other growths are smaller clusters. The Food Processing, and Construction Products and Services are in decline. Transportation and Logistics although not a specialization but is declining.

Appendix 9. - Other Cluster Analyses

Distribution and Electronic Commerce

Distribution and Electronic Commerce cluster is another spillover potential as indicated by the growth map (Figure 143). But is it?

Figure 143 Distribution and Ecommerce Revenue and Employment Growths.

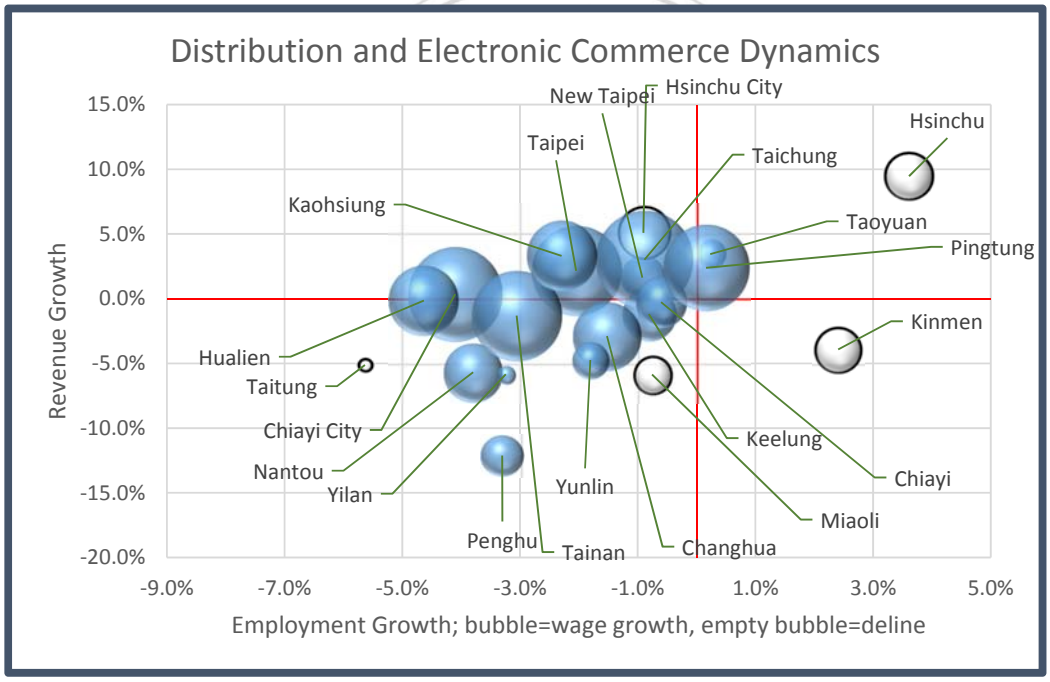


Source: *Taiwan National Statistics Bureau*

The growth map tells us that Hsinchu has the highest growth of revenue and employment but a smaller cluster. Taipei has the largest labor participation in this cluster but the employment is dropping despite the revenue is still rising. Further look into the dynamics of all growths in Figure 144. The clustering of wage rising along with the clusters not in

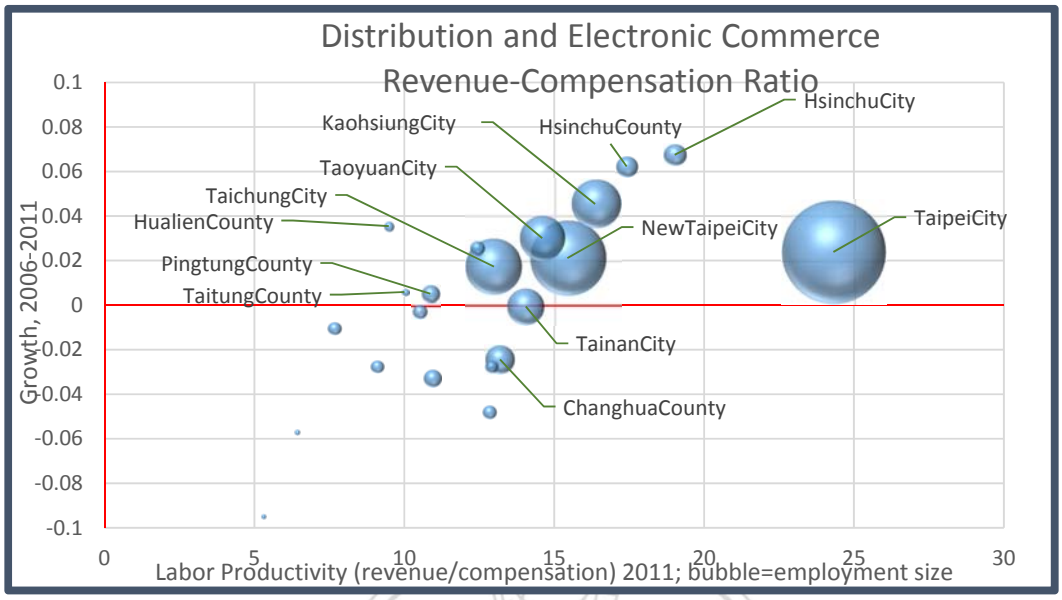
the Northwest regions. The wage rising is in other regions. Only Taoyuan and Pingtung are having all three growths. Revenue decline toward the south. Employment declines are problems in this industry. By further examine Figure 145, Taipei City has the largest workforce and highly profitable. Both Hsinchu city and county have highest productivity growth but smaller workforces. New Taipei, Taichung, Taoyuan, Kaohsiung share the similar productivity growth rates. The smaller Cities are facing declining labor productivity. This industry is facing wage rising, and revenue and employment declines. The high wage across the board ca be a sign of labor supply issue despite the larger cities with revenue rising, especially both Hsinchu. Miaoli is facing all declines. Changhua, Nantou, Yunlin, and Tainan are all facing large revenue declines.

Figure 144 Distribution and Electronic Commerce Cluster Dynamics.



Source: *Taiwan National Statistics Bureau*

Figure 145 Distribution and Electronic Commerce Labor Productivity.



Source: Taiwan National Statistics Bureau

Then followed by the agglomeration factor charts:

Figure 146 Agglomeration Potential for Distribution Electronic Commerce Industry.

Distribution and Ecommerce	Wage Growth	Revenue Growth	Employment Growth	Employment Size	Cluster Shares	Location Shares	LQ	Annual Average Wage in NT$1,000
New Taipei	0.5%	1.6%	-0.9%	160057	13.8%	19.8%	1.4	484
Taipei	1.9%	2.1%	-2.0%	298553	13.4%	36.9%	1.3	660
Keelung	0.7%	-1.2%	-0.8%	4847	7.0%	0.6%	0.7	412
Taoyuan	0.2%	3.4%	0.2%	57006	7.9%	7.0%	0.8	453
Hsinchu	-0.5%	9.5%	3.6%	11763	6.1%	1.5%	0.6	566
Hsinchu City	-0.7%	5.1%	-0.9%	12505	4.9%	1.5%	0.5	569
Miaoli	-0.4%	-5.9%	-0.8%	4837	3.4%	0.6%	0.3	383
Taichung	2.2%	3.0%	-0.9%	88532	9.4%	10.9%	0.9	447
Changhua	1.1%	-2.9%	-1.5%	22080	6.8%	2.7%	0.7	365
Nantou	0.8%	-5.7%	-3.8%	4390	5.1%	0.5%	0.5	369
Yunlin	0.3%	-4.7%	-1.8%	7992	6.9%	1.0%	0.7	340

Chiayi	0.6%	-0.3%	-0.6%	5854	6.9%	0.7%	0.7	360
Chiayi City	2.0%	0.3%	-4.1%	5953	9.9%	0.7%	1.0	375
Tainan	1.9%	-1.3%	-3.1%	38403	7.4%	4.7%	0.7	398
Kaohsiung	1.1%	3.3%	-2.3%	68422	8.7%	8.5%	0.9	421
Pingtung	1.7%	2.4%	0.2%	9038	7.3%	1.1%	0.7	369
Yilan	0.1%	-5.8%	-3.2%	4192	4.6%	0.5%	0.5	350
Hualien	1.1%	-0.1%	-4.6%	2365	3.9%	0.3%	0.4	351
Taitung	0.0%	-5.1%	-5.6%	1341	4.6%	0.2%	0.5	341
Penghu	0.4%	-12.1%	-3.3%	399	2.7%	0.0%	0.3	301
Kinmen	-0.5%	-3.9%	2.4%	574	4.5%	0.1%	0.4	308
Lienchiang	4.0%	-14.6%	9.8%	37	1.9%	0.0%	0.2	419

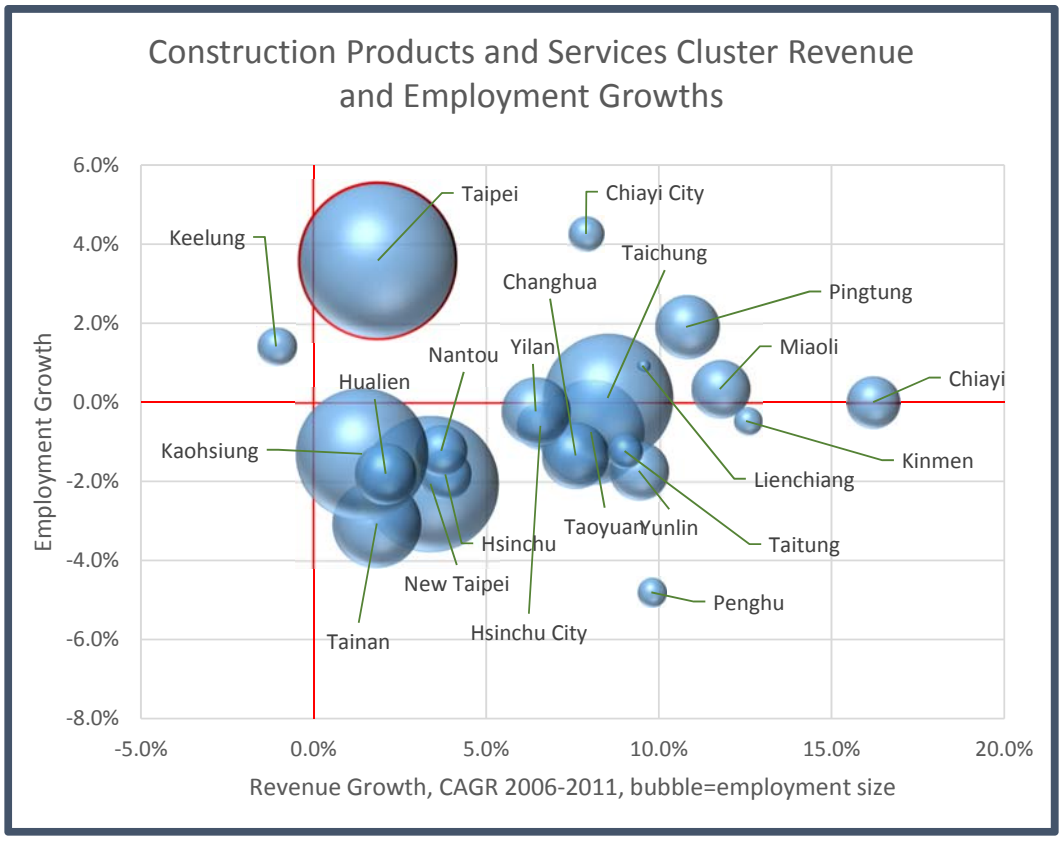
Source: *Taiwan National Statistics Bureau*

From Figure 146 that all the specializing Cities all have employment declines and they all have wage and revenue growths, and this is a strong indication of undersupply of labor. There are only two Cities with full growths on this cluster, which are Taoyuan and Pingtung, and both did not make the national specialization concentration. This is Taipei's specialization with wage growths of 1.9% but losing 2% employments, a sign of undersupply of available labor. Taipei has the least revenue growths, and with the rising wages, Taoyuan, although not a specialty yet but growing in 3.4% in revenues, is a candidate for potential spillovers. Pingtung, close to the Kaohsiung Port, is another City having all growth factors, but it has a very small participation shares within the cluster. It may take spillovers from Kaohsiung since Kaohsiung has wages rising but losing the employment. In the case of Distribution and Ecommerce cluster, Taipei is not having spillovers despite that wage and revenue are all rising but employment is dropping. The labor shortage is the issue in this cluster. Providing training for the required skill set is the right direction for this sector. This is especially true for the two fast growing cities of Hsinchu. With the rising wages, fast growing revenue, employment drop, and high profitability, the shortage of labor supply can impact the growth.

Construction Products and Services

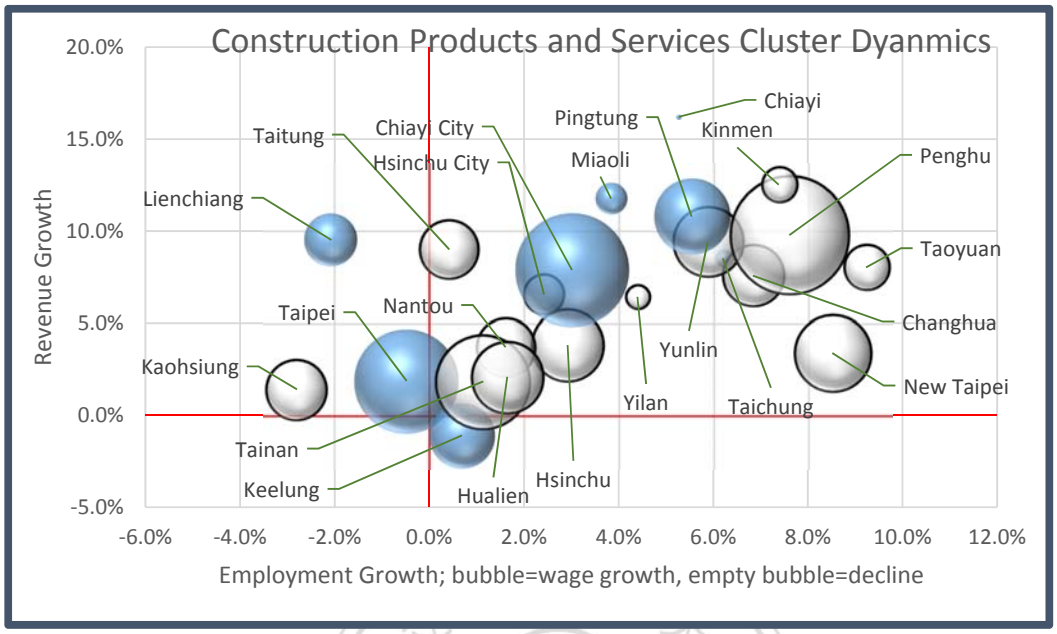
The fourth largest traded cluster is the Construction Products and Services. Taipei is the leading City for this cluster, and the two large Cities are in revenue decline. All the rest are doing pretty well with the exception of Keelung and Lienchiang. One thing worth noticing is that the wages are mostly dropping in this cluster despite that most are growing with revenue and employment (see Figure 148). This is a sign of oversupply of labor.

Figure 147 Construction Products and Services Cluster Revenue and Employment Growths.



Source: *Taiwan National Statistics Bureau*

Figure 148 Construction Products and Services Cluster Dynamics.



Source: *Taiwan National Statistics Bureau*

Below the Construction Products and Services cluster agglomeration factors.

Figure 149 Construction Products and Services.

Agglomeration Factors	Wage Growth	Revenue Growth	Employment Growth	Employment Size	Cluster Shares	Location Shares	LQ	Annual Average Wage in NT$1,000
New Taipei	-2.1%	3.4%	8.5%	36890	3.2%	13.7%	0.9	451
Taipei	3.6%	1.9%	-0.5%	49412	2.2%	18.3%	0.7	882
Keelung	1.4%	-1.1%	0.7%	2774	4.0%	1.0%	1.2	434
Taoyuan	-0.8%	8.0%	9.2%	21934	3.0%	8.1%	0.9	453
Hsinchu	-1.8%	3.8%	2.9%	5130	2.7%	1.9%	0.8	439
Hsinchu City	-0.6%	6.6%	2.4%	4424	1.7%	1.6%	0.5	438
Miaoli	0.3%	11.8%	3.8%	6829	4.8%	2.5%	1.4	443
Taichung	0.1%	8.5%	6.2%	32975	3.5%	12.2%	1.0	471
Changhua	-1.3%	7.6%	6.8%	8771	2.7%	3.2%	0.8	378
Nantou	-1.2%	3.7%	1.6%	5334	6.2%	2.0%	1.8	387
Yunlin	-1.7%	9.4%	5.9%	6868	6.0%	2.5%	1.8	377

Chiayi	0.0%	16.2%	5.3%	5371	6.3%	2.0%	1.9	402
Chiayi City	4.3%	7.9%	3.0%	2382	4.0%	0.9%	1.2	512
Tainan	-3.1%	1.8%	1.1%	15551	3.0%	5.8%	0.9	391
Kaohsiung	-1.3%	1.4%	-2.8%	34566	4.4%	12.8%	1.3	443
Pingtung	1.9%	10.8%	5.5%	8155	6.6%	3.0%	2.0	432
Yilan	-0.2%	6.4%	4.4%	9309	10.3%	3.4%	3.0	437
Hualien	-1.8%	2.1%	1.6%	7459	12.5%	2.8%	3.7	345
Taitung	-1.2%	9.0%	0.4%	2475	8.6%	0.9%	2.5	378
Penghu	-4.8%	9.8%	7.6%	1622	10.9%	0.6%	3.2	282
Kinmen	-0.5%	12.5%	7.4%	1594	12.5%	0.6%	3.7	423
Lienchiang	0.9%	9.5%	-2.1%	336	17.2%	0.1%	5.1	491

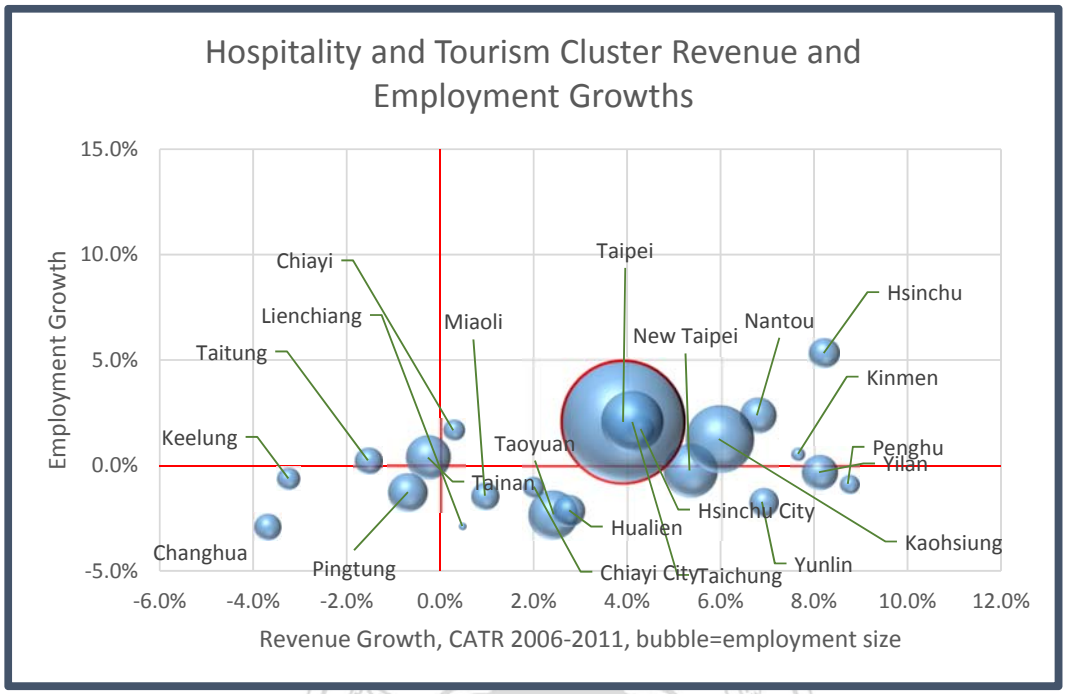
Source: *Taiwan National Statistics Bureau*

The Construction industry spreads out many cities, especially toward South and East regions. The largest workforce is in Taipei. The second largest workforce is in the New Taipei City. Neither these two Cities has the national specialty level. The third largest workforce is in Kaohsiung with a LQ of 1.3 but declining with the wages and employment. The two Cities with all growths are Chiayi City and Pingtung. These two are with over 10% revenue growths. These products and services primarily serve other regions instead of exporting. The revenue in this cluster in general is dropping.

Hospitality and Tourism

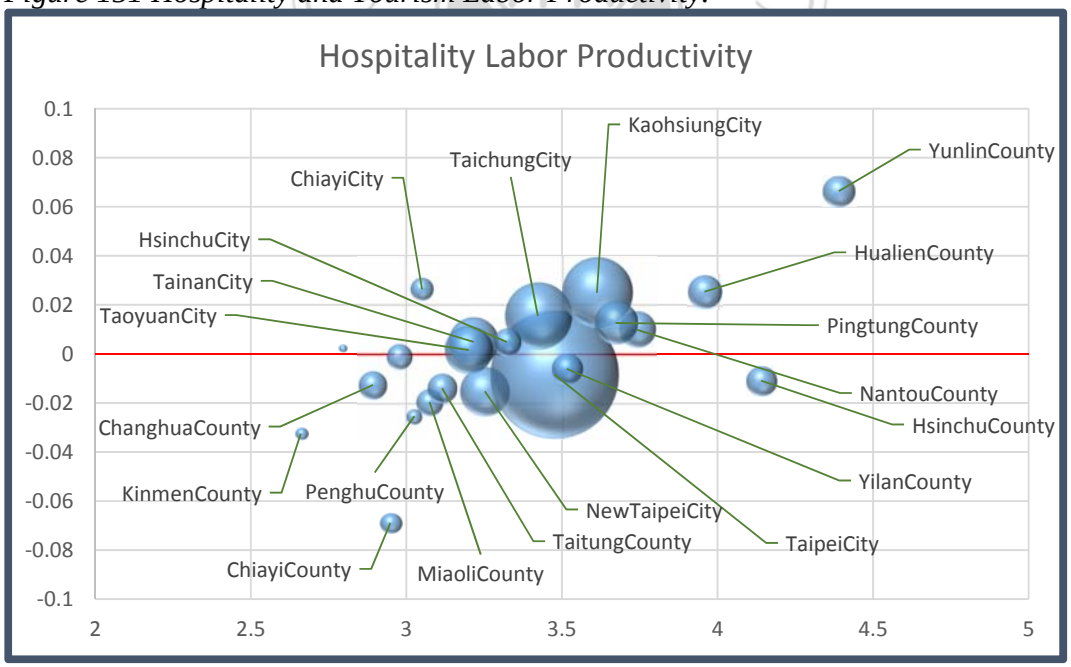
The dominated cluster is Taipei with 36% of employment of the cluster concentrated in Taipei. Kaohsiung is the next larger City, followed by Taichung. Most Cities have growth in revenue and employment. This is probably due to the latest tourists increase after ECFA is signed. Tourism has been dramatically increased after 2009. Most of non-industrialized cities are specializing in this cluster especially the Outer Islands and East districts and the mountain ridge areas. Taiwan has water sounding the whole island with a central mountain ridge, is a really good place for tourist attractions. The profitability is not as high as other production industries (see Figure 151); they range around 3.5 for the revenue-compensation ratio. Many cities have wage declines; the wage rising Cities are obvious the tourist attraction regions (See Figure 152).

Figure 150 Hospitality and Tourism Revenue and Employment Growths.



Source: *Taiwan National Statistics Bureau*

Figure 151 Hospitality and Tourism Labor Productivity.



Source: Taiwan National Statistics Bureau

The Agglomeration Factors:

Figure 152 Hospitality and Tourism Agglomeration Factors.

Hospitality and Tourism	Wage Growth	Revenue Growth	Employment Growth	Employment Size	Cluster Shares	Location Shares	LQ	Annual Average Wage in NT$1,000
New Taipei	-0.2%	5.3%	7.2%	9,858	0.8%	6.7%	0.5	365
Taipei	2.1%	3.9%	2.7%	53,037	2.4%	36.3%	1.3	547
Keelung	-0.6%	-3.2%	-2.5%	1,639	2.4%	1.1%	1.3	376
Taoyuan	-2.3%	2.4%	4.7%	8,250	1.1%	5.6%	0.6	373
Hsinchu	5.3%	8.2%	3.9%	2,942	1.5%	2.0%	0.8	435
Hsinchu City	1.7%	4.3%	2.0%	2,408	0.9%	1.6%	0.5	410
Miaoli	-1.4%	1.0%	4.5%	2,548	1.8%	1.7%	1.0	341
Taichung	2.1%	4.1%	0.5%	13,033	1.4%	8.9%	0.8	419
Changhua	-2.9%	-3.7%	0.5%	2,340	0.7%	1.6%	0.4	315
Nantou	2.4%	6.8%	3.3%	4,469	5.2%	3.1%	2.8	411
Yunlin	-1.7%	6.9%	2.0%	2,901	2.5%	2.0%	1.4	368
Chiayi	1.7%	0.3%	5.9%	1,547	1.8%	1.1%	1.0	365
Chiayi City	-1.0%	2.0%	0.4%	1,522	2.5%	1.0%	1.4	344
Tainan	0.4%	-0.3%	-1.1%	6,588	1.3%	4.5%	0.7	366
Kaohsiung	1.3%	6.0%	2.1%	15,690	2.0%	10.7%	1.1	387
Pingtung	-1.3%	-0.7%	-0.7%	5,147	4.2%	3.5%	2.3	399
Yilan	-0.3%	8.1%	9.1%	4,236	4.7%	2.9%	2.6	379
Hualien	-2.1%	2.8%	2.4%	3,503	5.8%	2.4%	3.2	363
Taitung	0.2%	-1.5%	-0.4%	2,458	8.5%	1.7%	4.7	359
Penghu	-0.9%	8.7%	12.5%	1,259	8.5%	0.9%	4.7	320
Kinmen	0.5%	7.7%	10.7%	606	4.8%	0.4%	2.6	342
Lienchiang	-2.9%	0.5%	3.2%	169	8.7%	0.1%	4.8	335

Source: *Taiwan National Statistics Bureau*

Hospitality and Tourism clusters are primarily concentrated in the Outer Islands and South regions. Nantou has one of the famous resorts, Sun-Moon-Lake which attracts tourists worldwide. The latest ECFA agreement signed with China recruited many tourists from China, and Sun-Moon-Lake is there must-visit site. Taipei has the largest workforce in this cluster, but Nantou is the only City enjoying all positive growths, and still has room to grow more capacity. On top of it, the tropical climate allows of fruits and vegetables to grow in varieties. Additionally, Taiwan is centrally located in the middle of East Asia, in the Japanese occupation time, Taiwan was used as the central hub

for the food trading in the region. There are a lot more can be developed based on the local endowments. Taiwan's food industry has reached its full potential, and there are potentials for food cluster initiatives.

Downstream Metal Products

Figure 153 Downstream Metal Products Growth Composition.

Business Services	Employment Growth	Revenue Growth	Wage Growth	Employment Size	Employment Shares	Location Shares	LQ	Annual Average Wage in NT$1,000
New Taipei	-21.0%	2.3%	1.3%	13,344	1.2%	18.6%	1.3	459
Taipei	-7.3%	2.3%	4.3%	6,176	0.3%	8.6%	0.3	689
Keelung	-22.1%	11.5%	6.7%	198	0.3%	0.3%	0.3	721
Taoyuan	-19.5%	-19.1%	1.2%	7,698	1.1%	10.7%	1.2	499
Hsinchu	-19.4%	-11.8%	6.0%	1,278	0.7%	1.8%	0.7	612
Hsinchu City	-22.6%	-12.7%	0.5%	441	0.2%	0.6%	0.2	443
Miaoli	-23.7%	-22.1%	-1.3%	1,036	0.7%	1.4%	0.8	382
Taichung	-23.4%	-18.2%	1.0%	10,244	1.1%	14.3%	1.2	425
Changhua	-16.6%	-17.8%	-1.7%	11,321	3.5%	15.8%	3.9	348
Nantou	-24.6%	-23.6%	-3.6%	554	0.6%	0.8%	0.7	316
Yunlin	-15.6%	-29.5%	0.5%	1,203	1.0%	1.7%	1.2	423
Chiayi	-16.4%	-7.3%	-1.9%	1,079	1.3%	1.5%	1.4	333
Chiayi City	-14.6%	-3.8%	0.3%	489	0.8%	0.7%	0.9	394
Tainan	-26.6%	-28.3%	-1.6%	5,439	1.0%	7.6%	1.2	379
Kaohsiung	-23.9%	-17.9%	5.2%	8,971	1.1%	12.5%	1.3	576
Pingtung	-17.1%	-3.3%	6.9%	1,111	0.9%	1.6%	1.0	517
Yilan	-9.6%	0.3%	-3.0%	958	1.1%	1.3%	1.2	365
Hualien	-38.2%	-35.5%	-2.0%	43	0.1%	0.1%	0.1	363
Taitung	-33.8%	-20.3%	0.9%	46	0.2%	0.1%	0.2	370
Penghu	-35.2%	-41.2%	-4.6%	11	0.1%	0.0%	0.1	265
Kinmen	-22.6%	-8.7%	4.8%	20	0.2%	0.0%	0.2	521
Lienchiang	0.0%	0.0%	0.0%	0	0.0%	0.0%	0.0	0

Source: Calculations based on Taiwan National Census Data

Downstream Metal is showing the largest declines in all traded cluster. By reviewing the growth rates, it is obvious that the revenue declines are driving the overall employment declines along with some revenue declines. Changhua is the most specialized City has a

full declining rate. This cluster has the drop on market demand which drives the decline in employment. This is the worst kind of situation.

Transportation and Logistics

Figure 154 Transportation and Logistics Growth Composition.

Business Services	Employment Growth	Revenue Growth	Wage Growth	Employment Size	Employment Shares	Location Shares	LQ	Annual Average Wage in NT$1,000
New Taipei	-14.9%	-2.1%	10.2%	19,526	1.7%	11.5%	0.8	666
Taipei	-9.6%	-0.7%	5.4%	58,207	2.6%	34.3%	1.2	881
Keelung	-17.3%	-2.6%	8.9%	3,248	4.7%	1.9%	2.2	668
Taoyuan	2.4%	28.5%	9.9%	22,202	3.1%	13.1%	1.5	836
Hsinchu	-1.1%	9.1%	1.1%	4,876	2.5%	2.9%	1.2	672
Hsinchu City	-6.4%	3.2%	5.9%	2,701	1.1%	1.6%	0.5	661
Miaoli	-7.9%	8.0%	7.8%	1,923	1.4%	1.1%	0.6	578
Taichung	-7.1%	8.1%	8.1%	16,735	1.8%	9.9%	0.8	611
Changhua	-3.0%	11.2%	8.6%	3,695	1.1%	2.2%	0.5	545
Nantou	-4.3%	9.7%	11.0%	1,250	1.4%	0.7%	0.7	573
Yunlin	-4.8%	11.4%	7.5%	1,956	1.7%	1.2%	0.8	665
Chiayi	-3.5%	17.1%	10.1%	1,172	1.4%	0.7%	0.7	486
Chiayi City	-11.4%	4.4%	7.1%	1,084	1.8%	0.6%	0.9	625
Tainan	-11.6%	2.5%	8.0%	5,992	1.2%	3.5%	0.5	516
Kaohsiung	-7.1%	5.7%	7.0%	19,177	2.4%	11.3%	1.2	586
Pingtung	-6.8%	8.4%	13.5%	1,658	1.3%	1.0%	0.6	624
Yilan	-5.2%	12.8%	10.4%	2,078	2.3%	1.2%	1.1	585
Hualien	-11.7%	6.8%	12.6%	1,148	1.9%	0.7%	0.9	575
Taitung	-13.2%	2.6%	8.9%	456	1.6%	0.3%	0.7	543
Penghu	-13.6%	-1.2%	10.0%	275	1.9%	0.2%	0.9	567
Kinmen	-0.3%	6.0%	5.8%	341	2.7%	0.2%	1.3	545
Lienchiang	-15.5%	2.6%	6.2%	37	1.9%	0.0%	0.9	597

This cluster has almost all revenue growths, wage growths, and employment declines. This cluster has a clear sign of labor pool shortage. Despite the revenue and wage growth, the employment is still declining. This can be that the outside wages are attracting the labor to exit Taiwan for better paid jobs. In fact, the airlines, shipping companies are in shortage of labor worldwide due to globalization. Many web orders have triggered the business booms in all markets.

Taiwan's Dynamic Analysis

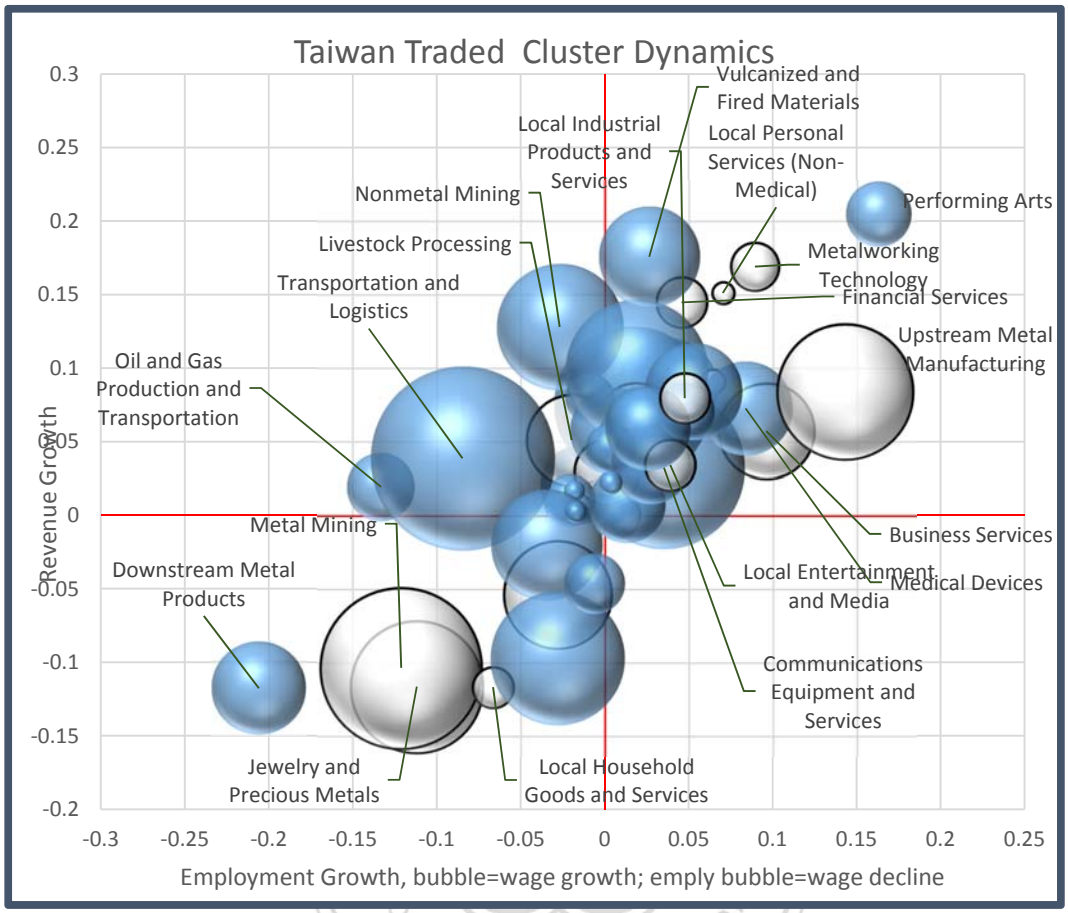
Figure 155 Taiwan's Growth Factors.

Business Services	Employment Growth	Revenue Growth	Wage Growth	Employment Size	Employment Shares	Location Shares	LQ	Annual Average Wage in NT$1,000
New Taipei	0.9%	8.4%	0.9%	1,160,288		14.5%		509
Taipei	1.1%	3.5%	1.6%	2,223,006		27.7%		752
Keelung	2.1%	6.7%	1.5%	69,310		0.9%		485
Taoyuan	0.1%	1.7%	0.6%	722,093		9.0%		457
Hsinchu	0.0%	1.1%	0.3%	191,301		2.4%		506
Hsinchu City	1.7%	3.1%	-0.5%	256,955		3.2%		397
Miaoli	2.1%	9.9%	2.0%	141,815		1.8%		575
Taichung	2.5%	1.8%	2.6%	941,930		11.7%		666
Changhua	4.5%	14.1%	1.6%	323,840		4.0%		520
Nantou	0.6%	-0.6%	-0.7%	86,587		1.1%		403
Yunlin	0.9%	0.7%	0.4%	115,320		1.4%		430
Chiayi	1.9%	7.1%	0.3%	84,781		1.1%		463
Chiayi City	2.6%	5.2%	-0.1%	60,096		0.7%		418
Tainan	2.3%	3.8%	0.9%	520,902		6.5%		412
Kaohsiung	-0.8%	-0.5%	-0.4%	785,904		9.8%		406
Pingtung	0.7%	2.5%	-0.6%	123,916		1.5%		422
Yilan	5.3%	1.6%	-0.9%	90,702		1.1%		355
Hualien	-0.5%	0.9%	1.0%	59,889		0.7%		507
Taitung	1.4%	-0.5%	5.5%	28,911		0.4%		853
Penghu	0.0%	0.5%	1.0%	14,814		0.2%		434
Kinmen	7.7%	7.0%	-0.6%	12,757		0.2%		458
Lienchiang	1.4%	2.4%	1.2%	1,955		0.0%		485
Total				8,017,072				579

How are these Taiwan's Traded clusters doing in the 5 years examined? Which cluster is better related to another cluster? The related clusters may have a similar growth rate with cluster supply-chain effects on revenues, especially to those clusters with upper and lower stream products in the same value chain, but sometimes, we see downstream behaves differently from the upstream clusters. In Taiwan's case, we see When downstream product businesses rise, it will impact the upstream productions and materials to gain momentum as well, but when upstream rises, it may not cause the

downstream business to go up since the downstream products are at a different market sector. From Figure 156 shows that the Downstream Metal is declining with a big rate, but the Upstream Metal Manufacturing and Metal Working Technology all have gains. Closely related clusters share labor pools. People who work in the closely related clusters have choices to move their jobs and ask for better wages; these clusters tends to growth with the same rates. The clusters in the Middle District display the clustering effect that the closely related clusters move in the same dynamics with similar growth rates. Basically, many shares orders among these clusters. Some very high paid jobs such as petrochemical engineering in the Oil refinery industries are short of manpower because these very specialized knowledge and skills may take longer to train, and there is no substitution for the special skills. In an area the regional market has not reached a mass to support the expansion of the regional clusters, these jobs are mostly stable due to the cluster spillover is smaller. This type of cluster may be more isolated and smaller too (Medical Devices and Biopharmaceuticals). For example, Taiwan is a place that does not have the oil endowments but buys oil to refine. The engineering requirement is in demand but very specialized in a small cluster. Another example, the downstream products of plastics and textile manufacturing require far different types of skills such as production machinery and assembly labor to produce the final products. This departs from the Oil refinery clusters which does not share the labor pools, thus, has different growth rates. The cluster map will demonstrate this fact.

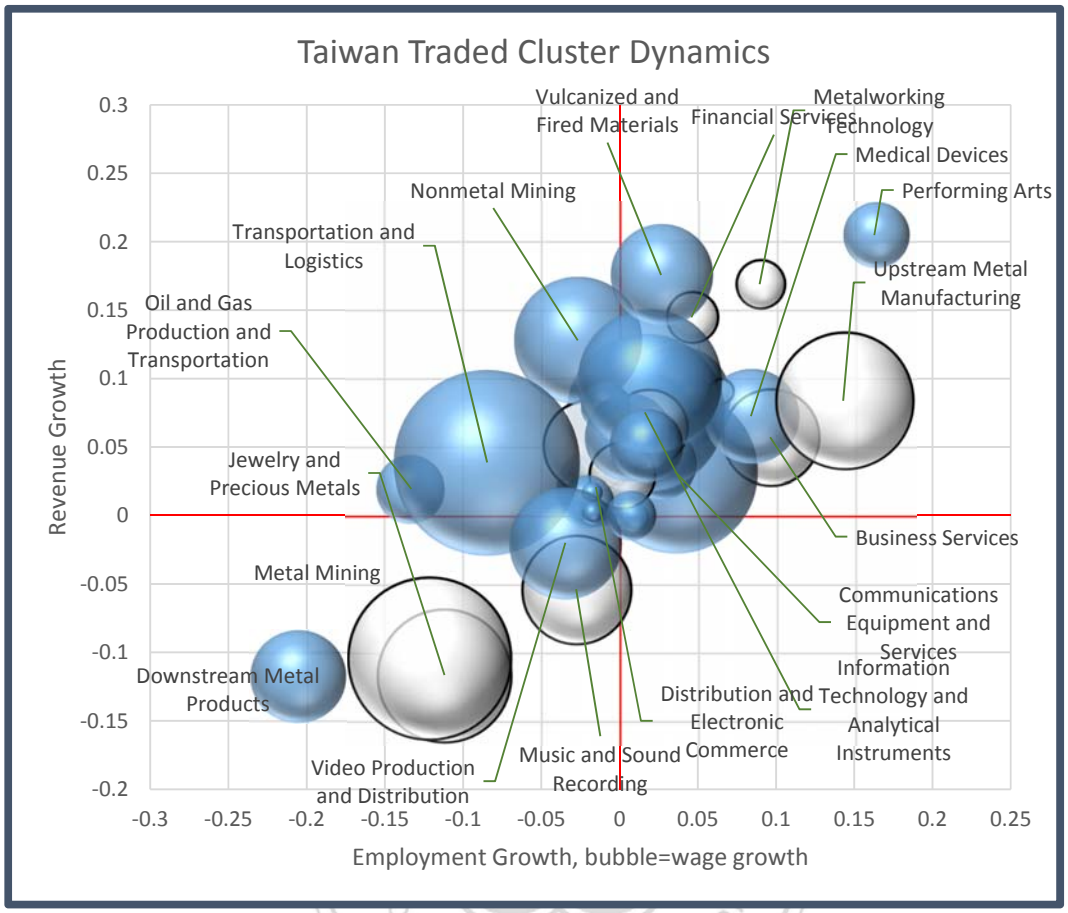
Figure 156 Taiwan Traded Clusters' Growth Dynamics.



Source: *Taiwan National Statistics Bureau*

Similarly, Figure 157 shows the Traded cluster dynamics on the three collective growths.

Figure 157 Taiwan's Traded Clusters Dynamics.



Source: *Taiwan National Statistics Bureau*

The fastest wage rise with growing employment is the Communications and Equipment Services cluster followed by Information Technology and Analytical Instrument cluster. The fastest revenue rise with rising employment is Performing Arts. The Performing Arts cluster is taking a lead on the employment growth rates. By the sheer size the Performing Arts is much smaller than the Communications Equipment and Products; it is one tenth of employment size of the Communication Equipment; therefore, the revenue growth rate is not as significant as the wage growths. The IT is a leading and dominated cluster and is gaining a full momentum from the three growth rates. Both wages and revenue are rising over 5%. Miaoli is having a fast growth from the IT spillovers from its neighboring City with an employment growth rate of 23%. This demonstrates a case the City level growth rate can give a more precise evaluation on the competitiveness. Next, we need to look down into the City level, which City has the concentrated specializations to determine

how to capture the potentials with matching policies or business strategies. At that juncture, cluster initiative may be brought to live for the cluster work. The worst wage decline is the Upstream Metal Manufacturing still with revenue and sizable employment growths. On the wage decline side, both the Metalworking Technology and Upstream Metal Manufacturing wages are declining despite of revenue gain. These two are closely related value chains mostly in the Middle District. Field survey has identified some problems such as “difficult to find middle management … Masters are retiring, and young people does not like to get their hands dirty… Our assemblers are mostly migrant workers, and locals do not feel comfortable… We need funding to upgrade business environment and automation machinery so that the factory has a more attractive working place…” The wage drop can be an effect of more migrant workers are working for lower wages in these clusters. Initiatives can be set to looking into migrant worker policies or skill training for the middle management labors to support the current demands for these clusters. The saddest thing is to see businesses losing their orders due to lack of labor supplies.

The employment loss clusters with revenue and wage growth rates map displays the worst declining cluster is the Leather and Related Products with all three factors largely declining, but this cluster is affected by the addition of Footwear Manufacturing cluster category, which split the numbers into two; therefore, it is treated as an outlier. The three other clusters declining are the Metal Mining, Jewelry and Precious Metals, and Music and Sound Recording clusters with all three factors declining. Cluster initiatives can be brought up to evaluate in details by Diamond framework to identify issues and recommendations, and making the initiatives to work. The Downstream Metal has wage risen, but the revenue and employment rates are both declining, so as the Video Production and Distribution. Are these clusters declining due to lack of trained labor, or is the business environment not competitive enough? Livestock is the only cluster that has revenues gain, but both wage and employment loss. Why is this? Is it because of the oversupply of labor? Maybe there are labor available from other clusters which are declining? The Transportation and Logistics cluster has the highest wage gain, and some revenue gain, but with employment decline. This is an indication that the employment decline is not due to revenue decline nor the wage decline. What is the reason for that? Is

the labor pool in shortage, so the wage goes high with revenue growth, but no one is available to work? Or does it require high skills, and the labor is not being trained fast enough? There can be many questions to ask when these factors interact with one another. The cluster mapping indicators are important to form actionable initiatives to boost the clusters into a more competitive shape. Every region has its own economic landscape, and the solutions are different for different problems. Each region should really discover the problems first and attack the problems with the right directions. Before this tool is available, the policy making precision is not down to the details by asking the right questions. The statistic modeling can tell the macro issues, but when it comes down to real practice, precision is required. There is no “one size fits all” policies. The national policy can only do so much to support industries. It is more accurate for the locals to find out their own issues and to identify solutions for a competitive business environment provided they have a timely assessment tool, and Taiwan’s Cluster Mapping is part of the solution. Further is a full analysis of Taiwan’s cluster mapping in every City and in more details. This dissertation is to design a tool to find industrial problems. The solutions depend on the locals to solve the problems with recommended cluster initiative framework.

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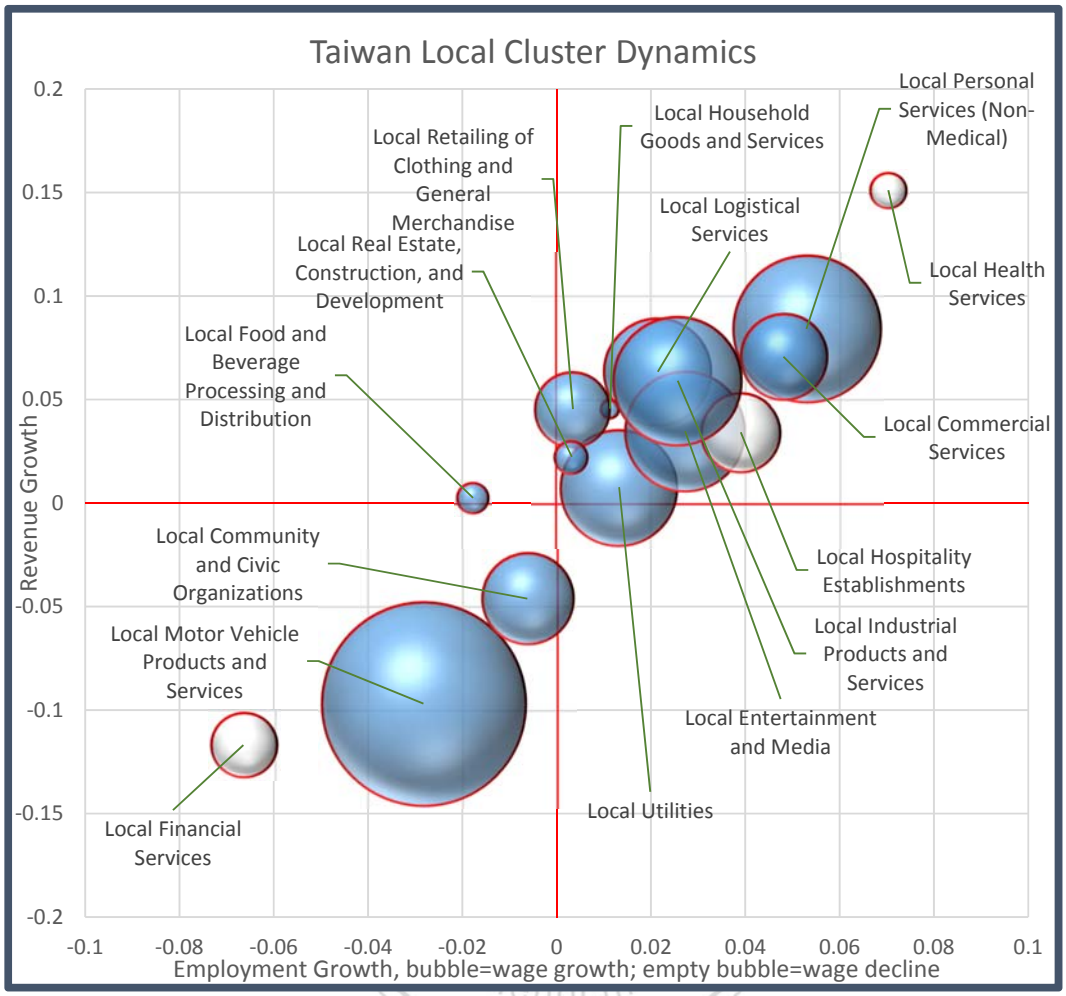
Figure 158 Taiwan Local Clusters Dynamics.



Source: *Taiwan National Statistics Bureau*