ECONOMIC GEOGRAPHY OF
INDONESIA’S MANUFACTURING INDUSTRY:
Dynamics and Changing Spatial Patterns

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ABSTRACT
A number of economists and business strategists have become more interested in spatial analysis, however, very few has examined the industrial clusters in Indonesia using provincial and district data simultaneously. Indonesia, as the world’s largest archipelago and 4th world most populous country, offers an excellent laboratory for testing both old and new industrial district theories. This article attempts to illuminate the clustering of Large and Medium Establishments (LME) industry in Indonesia and, hence, enrich our understanding of not only the regional development but also the relationship between urbanization and industrial development. Using Geographic Information System (GIS) and Moran’s I, we found hot and cold spots of industrial clusters. Unlike the majority of manufacturing in US and UK that has concentrated in a relatively small part of the country, within so-called the US manufacturing belt and UK’s Axial Belt of industry respectively, industrial clusters in Indonesia have concentrated geographically in Java’s metropolitan regions and major cities in the Outer islands. Our discriminant model suggests that the best predictor of clustering was population density, followed by income per capita, skilled workers, revenue sharing funds, infrastructure, productivity, and wages. Our study confirms that the LME industrial clusters are strongly associated with urban concentration.

Key words: industrial cluster, Indonesia, GIS, LME, discriminant, geography
JEL classifications: R12, J24, J61

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I. Introduction

With 241 million inhabitants ranked the 4th most populous country in the world in 2012 (BPS, 2013), Indonesia is the world’s largest archipelago and offers an excellent laboratory for testing both traditional and new industrial district theories. Since 1969, Indonesia’s economic development has been accelerated and the national goal of ‘Unity in Diversity’ (*Bhinneka Tunggal Ika*) has been accomplished. During the Soeharto era, hyperinflation was reduced substantially into one to two-digit inflation, a high rate of capital flight was reversed into substantial private capital inflows, foreign exchange reserve deficits were brought into positive, self-sufficiency level in rice production was achieved in mid-1980s, sustainable economic growth was generated, and poverty was reduced substantially (for example, Booth, 1992; Hill, 1996; Kuncoro, et al. 1997). In the period 1997-1999, the economic crisis resulted in an economic downturn of 2.9% per year, with the peak -13.1% in 1998. In the period 2000-2004, known as the period of economic recovery, the economy had a positive growth of 4.5%. Within the period 2005-2008, the economic growth has reached an average of 6%. The Indonesian government quite effectively steered the national economy through ‘storm’ of the 2008 Global Financial Crisis (Kuncoro, et al. 2009). Among the ASEAN-5, the Indonesian economy has proved to be remarkably resilient, with output growing at 4.5% in 2009 compared with 1.75% for the ASEAN-5 as a whole, thanks to strong domestic demand (Kuncoro, 2013).

This remarkable record in economic performance has been supported by the emergence of the manufacturing sector as a leading sector in the economy. Figure 1 shows the declining role of agriculture to GDP has been replaced by the increasing share of industry, especially the manufacturing sector. In 1965, the agricultural sector had the dominant share of GDP (56%), while the share of industry, including manufacturing, was only 13% of GDP. Indeed, with an average of annual growth of 11.9% and 6.1% during 1965-1980 and 1980-1994 respectively, industry has replaced agriculture as the leading sector in the Indonesian economy. In 1994, the industry contributed 41% to GDP, in which the manufacturing sector had played a significant role since it contributed 24% to GDP. At the same time the contribution of agriculture dropped drastically to only 17% of GDP, while its growth declined steadily from 4.3% per annum during 1965-1980 to 3.1% during 1980-1994. Furthermore, the manufacturing sector has played an important role in non-oil exports since it contributed to about 30% of non-oil GDP growth and about three-fourths of non-oil export growth during 1986-1992 (Abimanyu, 1996: 26). Nevertheless, manufacturing industry has grown below the Indonesia’s economic growth since 2005.

![Figure 1. Percentage share of agriculture and manufacturing industry to GDP: Indonesia, 1960-2011](source: Calculated from BPS, various years)
Given the increased importance of the industrial sector to Indonesia’s economy, it seems important to understand more fully patterns of industrial development, particularly its spatial patterns. Mainstream economics has made only limited progress toward integrating spatial considerations into its analytical corpus (Fujita, et al. 1999; Krugman, 1995; Krugman, 1998; Ohta and Thisse, 1993). There are only few rigorous studies that explore spatial analyses of industrial development in Indonesia, albeit with important exceptions (for example, Aziz, 1994; Dick, et al. 1993; Henderson and Kuncoro, 1996; Hill, 1990; Kuncoro, 2000b). In addition, Indonesian diversity in natural resources, population density, size of areas, and infrastructures makes it imperative to take into account spatial considerations in industrial and regional development. The lack of spatial consideration, together with the uneven development and an unstable central government, resulted in serious problems of regional insurrection during the 1950s (Hill, 1989; Kuncoro, 1996b, 2000c).

The major purpose of this article is to illuminate the regional clustering of Large and Medium Establishments (LME) of manufacturing industry in Indonesia and, hence, enrich our understanding of the regional development. LME in Indonesia consist of large establishments employing 100 workers or more, while medium establishments hiring 20 to 99 workers. Manufacturing industry is an economic activity involving processing materials and transforming them mechanically, chemically, or manually into finished or semi finished products and/or converting them into other goods having higher value and closer to the final user (BPS, 2015). The distribution of manufacturing establishments over space tends to cluster in certain Indonesia’s regions. We will show that LME manufacturing sector in Java and the Outer Island has tended to cluster in and around major cities and towns. Manufacturing firms in Java seek to locate in more populous and densely populated areas to enjoy both localization economies, which are associated with the size of a particular industry, and urbanization economies, which reflect the size of market of a district in a particular urban area (for example, Henderson, 1988; Kuncoro, 2000a). Manufacturing industries tend to concentrate geographically because agglomeration economies have the effect of reducing cost or increasing sales for many types of industry. An agglomeration represents not only a densely industrialised and urbanised region with diverse industrial structure, but also amplified by agglomeration economies stemming from provision of infrastructure services and public goods (Scott, 1993: 25-27). Manufacturing firms have tended to locate their sites in and around urban regions as the regions offer various advantages in terms of higher productivity and incomes that attract new investment, new technology, educated and skilled workers to a disproportionate degree (Malecki, 1991). For the proponents of the new economic geography, intersectoral linkages confined within these regions, together with thick labour market, represents one of the key centripetal forces that tend to pull population and production into agglomerations (Fujita and Thisse, 1996; Krugman, 1996: 7-10).

This paper attempts to analyze the dynamics of Indonesia’s LME manufacturing industry using spatial analysis and industrial district theories. In line with a dramatic increase in research on economic geography -- that is, on ‘where’ economic activity occurs and ‘why’ (Fujita et al. 1999), this paper will address the following fundamental questions: Where are the main locations of LME manufacturing industries in Indonesia? Why they tended to concentrate geographically in some metropolitan and urban regions?

II. Theoretical background: old vs new industrial clusters
An industrial cluster was initially associated with the Marshallian industrial district. Alfred Marshall (1919), first observed the disposition of certain kinds of industries to localise in specific areas in England, Germany and other countries, defined an industrial district as a specialised
geographical cluster of production. Interestingly, he distinguishes between ‘manufacturing town’ and an ‘industrial district’ as follows (Bellandi, 1989; Marshall, 1919: 285):

‘Almost every industrial district has been focused in one or more large towns. Each such large town, or city, has been at first the leader in the technique of industry, as well as in trade; and the greater parts of its inhabitants have been artisans. After a time factories, requiring more space than was easily to be had where ground values were high, tended to move to the outskirts of the city; and new factories grew up increasingly in the surrounding rural districts and small towns.’

Marshall highlighted the role of three types of external economy as giving rise to the industrial district: the concentration of a mass of skilled workers, the proximity of specialist suppliers and the availability of facilities for obtaining knowledge. The presence of a large pool of skilled workers facilitates economies of labour supply. The proximity of specialist suppliers produces economies of specialisation arising from an extended division of labour between firms in complementary activities and processes. The availability of facilities for obtaining knowledge enhances economies of information and communication via joint production, invention and improvements in machinery, processes and general organisation.

The relevance of Marshall’s work is reflected by the growing development of similar ideas in the more recent work of the Italian industrial district. Becattini (1990), for example, defines the industrial district as a ‘socio-territorial entity which is characterised by the presence of both a community of people and a population of firms and both tend to merge’. He tries to explain the Italian experience, especially in a region called the Third Italy (that is Tuscany, Emilia Romagna, and nearby regions), which have been perceived by many authors since the early 1980s as a model for the competitive success of clusters of small firms. Some major features of the structure of manufacturing in the Italian industrial districts are geographical concentration, sectoral specialisation, and predominance of strong network of small firms. These characteristics have been observed in Silicon Valley (US), West Jutland (Denmark), and Baden-Wurttemberg (Germany), Madrid, Fuenlabrada, Castellon, Mondragon and Valles Oriental (Spain) (Pyke and Sengenberger, 1992); and some cases from Africa, Asia and Latin America (Nadvi and Schmitz, 1994). However, a closer reading of those case studies reveals that there are substantial differences between them in terms of their origins and consolidation as industrial districts. Moreover, the applicability of the Italian model remains uncertain because of its highly specific socio-historical context, mainly culture and institutions (Zeitlin, 1992).

Traditionally industrial districts have been centres of craft industry. Craft based, design-intensive industries such as clothing, textiles, furniture, jewellery, ceramics, sporting goods, and so forth, are found in old centres of craft production such as the Third Italy, parts of France, Greece, Portugal, Germany, Spain, and Scandinavia (Scott and Storper, 1992). They may also be found in the inner city areas of large metropolitan regions such as New York, Paris, Los Angeles, and London. Modern-high technology clusters also emerge, such as ribbons, hardware, and specialty steel in St Etienne; edge tools, cutlery, and specialty steel in Solingen, Remscheid and Sheffield; and electronics in Southern California. Although a cluster is often characterised by a particular industry, this may incorporate various ‘sub-industries’. The obvious example is the electronics manufacturing cluster in Southern California with multi-faceted focus on computers, military and space communications equipment and avionics, and a diversity of components from printed circuit boards to advanced semiconductor devices (Scott, 1993: chap.7).

A notable case discussed in the literature is the Brazilian supercluster in Sinos Valley. In the 1960s it was a specialised cluster of craftsmen. Through success in export markets, by the
1990s it had become an internationally competitive industrial complex with flexible specialization between firms of different sizes, from small (less than 20) to very large (over 500 workers). Its emergence as a supercluster reflected increased depth and density of the local economy, which now includes almost the entire range of supply industries and producer services. Besides four hundred and eighty shoe manufacturers, there are 1,341 related firms in service industries: workshops, tanning industry, leather and footwear machine industry, component industry, rubber industry, leather article industry, export and forwarding agents. Two causes of this impressive development have been identified (Schmitz, 1995: 14). First, local and central government incentives yielded quick results because export agents had connected Brazilian producers with the United States market. Second, export growth increased the demand for local inputs and machinery, thus contributing to development of the cluster.

Since the 1980s a post-Fordist literature has drawn attention to the flexibility (flexible specialisation) and dynamism (employment generation) of industrial districts. As in the case of the Brazilian supercluster, the elements of a cluster can be linked in three ways: (1) vertically or convergently, when different stages of a process are involved, as in the case of spinning or weaving or where assembly lines are fed by different sub-processes; (2) laterally, where the same stage in a like process is involved, as in the case of men’s clothing and women’s clothing; and (3) diagonally, when service processes are involved, such as repairing, trading, collecting, and so forth. (Bellandi, 1989; Florence, 1961). Empirical studies have identified as major reasons for the growth of industrial clusters and districts: (1) concentrations of highly specialised knowledge, inputs and institutions, (2) the incentives of local competition, (3) the presence of sophisticated local demand for a product or service, (4) geographical, cultural, and institutional proximity, and (5) a proliferation of many different producers, all locked together in mutual interdependence through their transactional relations (Porter, 1994, 1998a; Scott, 1993: chap.2).

The new form of industrial district derives from the industrial complex model, which emerged from classical and neoclassical economics. The main features of the industrial complex model are: (1) sets of identifiable and stable relations among firms which are conceived primarily in terms of trading links; (2) minimisation of spatial transaction costs (that is transport costs, telecommunication costs, shipment costs) in the formation of crucial, pre-planned or identifiable linkages (Gordon, 2000). This model is in line with the Markusen’s and Whittaker’s study suggesting the importance of vertical inter-firm linkages between LME and small and cottage establishment (SCE) of “new” industrial districts in the USA and Japanese urban regions (Markusen, 1996; Whittaker, 1997). A study of industrial districts in Japan shows the large concentration of very small firms in the metropolitan centers of Tokyo, Osaka, and Nagoya (Whittaker, 1997). Unlike hundreds of small firm clusters called sanchi, which produce traditional or semi-traditional goods and tend to locate outside the main urban centres, Japanese metropolitan concentrations are remarkable both for their scale and the high proportion of small firms with their localised industry (jiba sangyo).

Building upon the pioneering work of Porter (1990) on competitive advantage, recent research has begun to link the literature on sub-national clusters with that on firm strategy and innovation (Enright, 1998; Porter and Solvell, 1998). The new theory of the firm with its emphasis upon transaction costs and the transaction environment has great power to elucidate the location decision of the firm. Region-specific resources, information flows, innovation, technological spillovers and the formation of industry-specific skills can thereby be studied within a consistent framework that has regard to both efficiency and dynamic effects (Porter and Solvell, 1998: 441-2, figure 19.1). Porter (2003) found that the performance of regional
economies is strongly influenced by the strength of local clusters and the vitality and plurality of innovation.

Unlike majority of previous studies, this study used combination of regional spatial data and discriminant model to identify changing spatial patterns of LME manufacturing industry with special reference to Indonesia. This study will fulfill the gaps, especially studies on industrial districts and regional development for Indonesia using a discriminant model. Unlike most previous studies that have discussed Indonesia’s regional development at the provincial level (e.g. Aziz 1994; Hill 1989; Manning 1997), this study will examine changing spatial patterns of Indonesia’s industrial development at the district (kabupaten/kodya) as well as provincial level. Every study, which relies on provincial data, has at least two major shortcomings (Kuncoro 2000b: 11, 2012). First, provincial data tend to obscure urban economies. The province is either too large or too small a unit. Even such large cities as Bandung, Semarang and Surabaya cannot be seen in provincial data. Whereas the capital city region of Jakarta actually spills over its provincial borders. Second, provinces are a much too large unit of analysis for any spatial analysis of agglomeration economies (Gelder 1994: 64) as the heterogeneity within each province would be too great. The disaggregation into districts, and even at the lower level (subdistrict or kecamatan), enables us to understand the dynamic of regional clustering in some districts across provinces.

III. Methodology

Spatial concentration of economic activities within a country indicates that industrialisation constitutes a geographically selective process. Within the USA, for illustration, the majority of manufacturing has been concentrated in a relatively small part of the country, within the so-called manufacturing belt, since the second half of the nineteenth century (Krugman, 1991: 11-4). Spatial concentration is also found in the UK’s Axial Belt of industry and the manufacturing belt of German Ruhr (Hayter, 1997: 45). This is also found in the case of Indonesia, and to much extent the island of Java. Despite the fact that regional clusters are usually associated with large cities, clusters can be also located in small and medium-sized towns. As illustration, in Massachusetts a plastics cluster lies in the western part of state, jewelry on the Rhode Island border, fiber optics around Sturbridge, textile and apparel near New Bedford and Fall River (Porter 1994, 1998b).

This section will elaborate upon the methodology to identify LME industrial clusters. It also attempts to illuminate on which regions the LME manufacturing industries tend to cluster in Indonesia. The location of industrial clusters at the district (kabupaten/kodya) level will be examined by using the Geographic Information System’s (GIS) approach and Industrial Survey data collected annually by Central Bureau of Statistics of Indonesia (BPS). The GIS is a useful tool to identify the location of industry and where the manufacturing industries tend to cluster (Kuncoro, 2001). The Industrial Surveys provide not only regional distribution of manufacturing establishments but also their dynamics from 1976 to 2010. The surveys provide the plant-level data of LME manufacturing firms, with more than 20 workers, that can be disaggregated by industry code (ISIC) and district, providing all data of industry-specific variables.

A growing awareness of the limited explanations offered by the traditional location theory has led to the surge of new economic geography, namely geographical economics (Kuncoro, 2000a; 2012). A growing number of economists have become interested in the study of location problems (for example, Krugman, 1995; Lucas, 1988; Fujita, et al. 1999), which triggered a new tool which has made an interesting contribution to geographical economics.
One of the major trends in the economic geography is employing the GIS in a socio-economic context that focuses on the processes acting spatial data in its passage through information system. A GIS is a special type of information system, concerned with the representation and manipulation of a geographic reality. GIS transforms data into information by integrating different data sets, applying focused analysis and providing output, all in manner to support decision making (Juppenlatz and Tian, 1996: chap.1). The inventory, analysis, mapping and modelling capabilities of GIS inevitably has wide application in a range of discipline, ranging from information technology to socio-economic or population-related data (Martin, 1996: 4-5). Application of GIS in Indonesia has become more widespread (East Asian Executive Reports 1996; Juppenlatz and Tian 1996: 103-108). In this study, we follow some typical procedures involved in creating and using GIS. It includes data acquisition, preliminary data processing, database construction, spatial search and analysis, and graphical display and interaction (Kuncoro, 2012).

To identify industrial clusters, we apply the following steps. First, we rank all districts in Indonesia for LME industry by employment and value added. Ranking all districts in terms of both employment and value added in LME manufacturing industry reveals that these establishments are unevenly distributed across Indonesia’s regions. Figure 2 and 3 show that the distribution of employment and value-added by districts is skewed rather than normal statistically. The positive skew of the histograms indicates that there are some districts possess high industrial density (in terms of employment and value added), while most contain very low industrial density.

![Figure 2. Employment distribution by district in Indonesia 2001 and 2010](source: Calculated from BPS)

Second, we map the employment and value-added data of LMEs to show where the industrial and non-industrial clusters are located. For mapping purposes, a kotamadya (city) is included in adjacent kabupaten or municipality (for example, kotamadya Semarang in kabupaten Semarang). In this step, we differentiate between industrial and non-industrial districts by setting a certain criteria (that is very high, high, moderate, and low) based on the total employment and value added of each district (kabupaten/kotamadya). Industrial clusters are identified by either “high” or “very high” industrial density in terms of both employment and value added. By employing these criteria simultaneously, most of the top districts with ‘high’ or ‘very high’ total employment and value added are found predominantly in Java, particularly in and around its major cities namely Jakarta, Surabaya, Bandung, Semarang, and Surakarta. The same pattern also occurs in the Outer Java Island, as most LME establishments are found in and around main
population centres such as Medan, Batam, Samarinda, Palembang, Pontianak, Ujung Pandang, and Denpasar. The other kabupaten/kotamadya can be regarded as non-industrial areas since their role in industrial employment and value added is minor.

Figure 3. Value added distribution by district in Indonesia 2001 and 2010
Source: Calculated from BPS

Empirical cluster research has contributed to the understanding the process of cluster formation. Some experiences with the use of local spatial methods like local Moran’s I and Getis-Ord Gi tests in pattern recognition have been already available. Moran's I is a measure of spatial autocorrelation developed by Moran (1950). In contrast, other measures, such as location quotients, examine only the value for a single areal unit without reference to values in neighboring areas. Our study utilises Moran’s I to examine spatial autocorrelation that is characterised by a correlation in a signal among nearby locations in space. Assessment of industry location and density patterns becomes the first phase in the identification of potential cluster regions to be included in a cluster driven development policy. Our study uses Getis-Ord Gi in the identification of potential cluster regions in the Indonesia’s LME industry.

One of major issues in economic geography: why do LME concentrate geographically in some regions? More specifically, we will use discriminant model to show to what extent Indonesia’s foremost LME clusters represent industrial districts with distinctive features. If we may classify those districts as a “separate” group from the rest of Indonesia, can we build a predictive model, with group membership based on observed characteristics of each region?

Discriminant analysis is widely applied to serve the twin objectives of discrimination and classification. Group separation is achieved by means of a discriminant function, while identification of future individuals is handled through a classification rule (Krzanowski and Marriott, 1995: 1). Discriminant analysis is a statistical technique for classifying individuals or objects into mutually exclusive groups on the basis of a set of independent variables (Kuncoro, 2006; 2013). Unlike regression analysis, the objective in discriminant analysis is to find a linear combination of the independent variables that minimise the probability of misclassifying individuals or objects into their respective groups (Dillon and Goldstein, 1984: 360-3). The overall test of relationship between predictors and groups in the discriminant analysis is the same as the test of the main effect in multivariate analysis of variance (MANOVA), where all
 discriminant functions are combined and grouping variables are considered simultaneously (Tabachnick and Fidell, 1996). In other words, MANOVA allows us to look at how groups differ, while discriminant analysis allows us to predict what variables discriminate between two or more groups.

The discriminant function analysis was performed to predict the membership of Indonesia’s foremost LME industrial districts. To keep the analysis as simple as possible, we dichotomise all districts into foremost industrial clusters versus the remainder as non-industrial clusters. Modelling using discriminant approach is suitable given the data available. Our discriminant function is based on the following equation:

\[ D_{ik} = a + d_iX_1 + d_jX_2 + d_kX_3 + d_lX_4 + d_mX_5 + d_nX_6 + d_oX_7 \]  \hspace{1cm} (1)

This study attempts to explore spatial discriminant patterns by contrasting discriminative characteristics of distinct spatial entity classes using some predictors: productivity of labor \((X_1)\), population density \((X_2)\), skilled workers \((X_3)\), income per capita \((X_4)\), infrastructure \((X_5)\), revenue sharing funds \((X_6)\), and average wages \((X_7)\). We transform the predictors into natural logarithm in order to normalise the distributions, which are positively skewed.

*Productivity of Labour.* Porter (1998) pointed out that industrial clusters, characterised by geographic concentrations of interconnected companies and institutions in a particular field, appeared to be far more productive industrial organizations than those based on one or two huge, diversified cities. We define the productivity of labour as the ratio between value of output and total employees. We test whether higher productivity of LME will influence the decision of LME to cluster.

*Population density.* We use the population density by district as to show the effect of generically named external economies of urbanization (Costa-Compi and Viladecans-Marsal, 1999: 2090). We will test whether a greater population density within a district corresponds to greater probability that LME choose to locate in that region.

*Skilled workers.* Skilled workers are viewed by the Neo-classical school as a central factor in the location decision of manufacturing establishments. A specific agglomeration economy is that more highly educated and skilled labour concentrates disproportionately in main cities. The theory of human capital is frequently applied to analyse the effect of education on labour earnings (Tachibanaki, 1998: 3). We will test whether higher skilled workers correspond to greater probability that LME choose to locate in industrial districts.

*Income Per Capita.* We include Gross Regional Domestic Product per capita as a proxy of market size. Krugman (1991: 23-4) argued that the more populated locations will attract a concentration of manufacturing production, assuming that the location offers a sufficiently larger local market than others, and fixed costs are large enough relative to transport costs. We will test the Krugman’s hypothesis.

*Infrastructure.* There is a substantial empirical literature showing that income and production are correlated with market access in the way suggested by new economic geography models. Fujita et al. (1999: 233-236) argued that a hub or a port city provide the city’s site with an advantage over other sites. A fundamental question in regional and urban economics is whether lower transport costs cause agglomerations to develop, or if, instead, they promote the dispersion of economic activity. In an influential paper that started this literature, Krugman (1991) shows the opposite: reducing transport costs causes agglomeration. Other theories have more nuanced predictions, and the absence of sharp predictions demands credible empirical work. We will test different theories of transport costs and economic geography, so that we can better
predict which regions will benefit from infrastructure improvements, and which regions may suffer.

**Revenue Sharing Funds.** These funds are central government transfer to regions reflecting resource endowments are agglomeration forces as argued by neo-classical economists, such as Heckscher-Ohlin (H-O). The H-O analysis establishes that “comparative advantage is determined by the absolute distribution of resources between countries and particularly by the relative factor endowment ratios between countries” (Johns, 1985: 178-81). East Kalimantan, Riau, Aceh, Bangka Belitung are provinces that enjoyed higher revenue sharing funds because they are known as resource rich regions (Figure 4). East Kalimantan, Aceh, and Riau are the major producer of oil and gas in Indonesia. East Kalimantan is also home of coal mining and forestry products. Bangka Belitung, as a new province splitting from South Sumatra, offers a great tin mines and beauty of its nature based tourism. We will examine whether high revenue sharing funds attract LME industry to locate in those regions.

**Wages.** Wages are one of the important variable in labour economics. Kuncoro (2007; 2012) found that wages are important in the textile, wood and miscellaneous industries but turn out to be a less important variable in more modern LME industries such as machinery, chemical, and paper. The story of wage trends in Indonesia, however, does not fit either with the modified Lewis model or a neo-classical theories interpretation of sharply rising wage rates associated with rapid economic growth (Manning, 1998: 114-131). Two features of the Indonesian labour market transformation are relevant to our study; (1) the increasing share of non-agricultural, urban and wage workers in total employment; and (2) a substantial increase in the number of non-wage workers in urban areas (Manning 1998: 111-2). We include a labour cost variable (WAGES), which is measured as wages for production workers, both male and female. We will test whether the increase in wages will encourage LME to cluster in industrial districts.

![Figure 4. Revenue Sharing Funds By Province](source.png)

Source: Ministry of Finance (2013)
IV. Findings and Discussions

1. Where are LME industrial clusters?

Most of Indonesian modern manufacturing establishments have persisted to cluster predominantly on Java and to a much lesser extent, Sumatra Island during 1976-2010. Even when we classify 33 provinces of Indonesia into five main islands (that is Sumatra, Java, Kalimantan, Sulawesi, Eastern Islands), Java and Sumatra provided more than 93% of Indonesia’s employment and value-added over the period (Table 1). Java contributed about 75-89% of Indonesian industrial employment and value added from 1976 to 2010, although this dropped slightly during 1995-2001. Java’s share declined from 89% and 86% in 1976 to 84% and 76% in 2010 in terms of industrial employment and value added respectively. Sumatra’s share grew from 7 to 12% in terms of industrial employment and from 11 to 18% in terms of industrial value added in the same period. Other main islands in Indonesia played a minor role in the Indonesia manufacturing employment and value added. Even when we sum up the share of Kalimantan, Sumatra, and Eastern Island, their share in Indonesian employment and value added was about 4% and 7% respectively over the period of 1976 to 2010.

Comparison between provinces in Java and the other islands in Indonesia is even more pronounced. The share of each Java’s provinces in terms of total employment and value added is relatively higher than other provinces or islands in Indonesia from 1976 to 2010 (Table 2). Major industrial regions in Java are found in its western and eastern part -- West Java, Jakarta, and East Java --which contributed more than 50% of total employment and value added. This infers relatively heavy regional clustering of manufacturing establishments in Java’s vis-à-vis the rest of the economy.

### Table 1. Role of Java in the Manufacturing Employment and Value Added, Indonesia 1976-2010 (% of total)

<table>
<thead>
<tr>
<th>Province/Island/Region</th>
<th>Employment</th>
<th>Value Added</th>
</tr>
</thead>
<tbody>
<tr>
<td>Jakarta</td>
<td>15.2</td>
<td>13.8</td>
</tr>
<tr>
<td>West Java</td>
<td>19.1</td>
<td>23.3</td>
</tr>
<tr>
<td>Central Java and DIY</td>
<td>24.1</td>
<td>17.1</td>
</tr>
<tr>
<td>East Java</td>
<td>30.6</td>
<td>24.5</td>
</tr>
<tr>
<td>JAVA</td>
<td>89.1</td>
<td>78.6</td>
</tr>
<tr>
<td>SUMATRA</td>
<td>6.7</td>
<td>12.2</td>
</tr>
<tr>
<td>KALIMANTAN</td>
<td>1.8</td>
<td>5.6</td>
</tr>
<tr>
<td>OTHER EASTERN REGION</td>
<td>2.4</td>
<td>3.7</td>
</tr>
<tr>
<td>INDONESIA</td>
<td>100.0</td>
<td>100.0</td>
</tr>
</tbody>
</table>

Source: Calculated from BPS; Putro (2013)

There have been changing patterns in Java’s employment for the last two decades (Figure 4). First, the declining share of Jakarta in the country’s employment, albeit persistently substantial in absolute value, has been offset partly by the rising share of West Java, East Java, and Central Java’s employment. In 1976 East Java was the top contributor to Java’s employment, followed by Central Java-DIY, West Java and DKI Jakarta (Recall Table 1). East Java has sustained this record up till the mid of-1980s. However, a decade later the role of East Java declined substantially and was replaced by West Java.
The second essential pattern is that almost every Java province showed a declining share in the Indonesia’s manufacturing employment. In 1976 DKI Jakarta, Central Java-DIY, and East Java accounted for 15.2%, 24.1% and 30.6% of the Indonesian employment respectively. These figures dropped substantially to be 10.7%, 13.6% and 22.8% in 1995. In contrast, West Java has played a larger role in the country’s employment since its share increased from 19.1% in 1976 to 35.2% in 1995, but declined to 28.2% in 2010.
The emergence of West Java and the declining share of DKI Jakarta in terms of employment should be interpreted carefully. This is due to the fact that many industries have expanded their activities around Jabotabek, an extended region which include Jakarta urban area (DKI Jakarta) and its adjacent municipalities in West Java, namely Bogor and Tangerang (Botabek). Rapid and massive industrial relocation has occurred as a lot of industries have moved out of Jakarta to the outskirts to take advantage of lower costs and wages. The share of Jabotabek employment located in Botabek rose from 43 to 56% between 1986 and 1991, while 73% of all plant births in Jabotabek in the larger corporate sector occurred in Botabek for 1989-1991 (Henderson, et al. 1996: 83-5).

In terms of value added, the picture is far more striking (Figure 5). When we combine West Java and DKI Jakarta, this region dominates the Indonesian manufacturing value added. These two provinces contribute more than 50% of the country’s value added. However, a closer look at the district level indicates that manufacturing establishments grow unevenly within West Java and cluster particularly in and around Jabotabek and Bandung. We will show using GIS that analysis using provincial data rather than municipality data blurs the dynamic of industrial spillover across administrative border. Therefore, the next section will analyse the Jabotabek region as a whole rather than separate Jakarta and its surrounding municipalities (Botabek).
Outside Java the location of LME manufacturing tend to cluster in and around the region’s major cities and towns. At the provincial level, the major locations of LME manufacturing firms in the Outer Island are found in North Sumatra, Riau, South Sumatra, West Kalimantan, East Kalimantan, and South Sulawesi (recall Table 2). Known as either resource rich or relative densely populated regions (for example, Hill, 1989, 1990), the distribution of LME manufacturing sector in these provinces clusters heavily in a few districts (Table 4). In North Sumatra most of the manufacturing firms --particularly aluminium, food, and plywood-- tend to concentrate in Medan, Deli Serdang, and Asahan. In Riau basic metal products and plywood firms tend to cluster in Kepulauan Riau, Bengkalis and Batam Island. In South Sumatra most firms, particularly fertiliser, food and cement, are concentrated in Palembang and Musi Banyu Asin. In West Kalimantan, timber and rubber processing firms are located in and around Pontianak. Samarinda, Kutai, Bulungan, and Bontang are the major location of manufacturing firms, particularly plywood and fertiliser, in East Kalimantan. In South Sulawesi, manufacturing activities has located overwhelmingly in Ujung Pandang, and to lesser extent Pangkajene Kepulauan.

In the Outer Island, large regional clusters are found in: (a) Batam Island and (b) Medan. In terms of employment, both are much smaller than the main industrial areas in Java but contribute substantially to value added. By value-added, Batam is slightly larger than Bandung metropolitan regions but by employment it ranks only seventh (Kuncoro, 2012; 2004). Since the mid-1980s Batam has developed rapidly in terms of infrastructure, investments, export, tourism, and the manufacture of electronics (Smith, 1998: tables 18.1,18.2; Yuan, 1995: tables 12.1,12.2). However, Batam is not an autonomous industrial agglomeration but an outlying industrial estate of Singapore, just forty minutes away by ferry. National borders and differential regulations allow land and labour to be much cheaper on Batam than on Singapore. As a product of both policy and market forces, Batam, like Johor Baru in Malaysia, has become closely enmeshed with Singapore as part of the Singapore-Johor-Riau (SIJORI) Growth Triangle. Its situation is quite unlike that of most of the rest of the province of Riau, whether the adjacent islands or the main island of Sumatra (Hill, 1996: 217). Batam must therefore be studied as part of the urban economy of Singapore.

Medan has a long history as a centre for plantation industries such as rubber, tobacco and oil palm, and its province of North Sumatra is still the most prosperous region in Sumatra.
(Barlow and Wie, 1989). By employment and value-added, Medan regional clusters, including Deli Serdang, achieves ranking with the main industrial areas of Java.

Other industrial areas in the Outer Island contribute only marginally in terms of employment and value added. Palembang, whose role is significantly underestimated by exclusion of oil refining, includes both heavy industry (fertiliser, cement) and resource processing (tin, timber, and agro-industries). Samarinda’s LMEs are narrowly specialised in the timber industry, including saw mills, furniture, and plywood. Pontianak has a broader industrial base consisting of crumb rubber, rubber-milling, coconut oil and paper industries, which are nevertheless all resource-based. Other industrial areas in the Outer Island, such as Ujung Pandang, are minor in terms of employment and value added.

Some major patterns with respect to industrial clusters in Indonesia can be drawn. First, Indonesia’s rapid industrial development under the New Order was heavily biased towards the island of Java. The predominance activities in Java might be explained as follows. First, historically the core of both the modern state and economy was moulded on Java during the course of the nineteenth century, with the development of the plantation economy under the Cultivation System (Dick, 1996). Second, the spatial pattern can be fairly readily explained by the attraction of labour- and skill-intensive industries to heavily populated Java, compared with the attraction of resource-based industries to the Outer Islands. In the Outer Island, regional clusters can be associated with resource-based industry and urban attraction. The former is found in the case of Asahan, Kepulauan Riau, Musi Banyu Asin, Bulongan, Kutai. The latter is represented by the emergence of Medan and Batam, and to a lesser extent Samarinda, Ujung Pandang, Palembang, Pontianak, and other cities.

Getis-Ord’s Gi is proved useful in identifying clusters, particularly since it examines patterns of LME co-location, or clusters, across areal unit boundaries within a specified neighborhood district. Smith et al. (2003), for an example, has tested Getis-Ord Gi in the U.S floriculture industry to measure spatial autocorrelation at the local level and identify “hot spots”, or concentrations in spatial distributions in which areal units and their neighbors have similar values of a given phenomena; a high Gi value indicates that high values are clustered near each other, whereas a low Gi value is low spatial cluster (“cold spot”) indicating of low values being near each other.

Figure 6 indicates that employment growth of LME (growthcap) has a positive value of 0.6525. It illuminates how spatial clusters of LME industry tended to concentrate on certain districts. We may identify the hot and cold spot of LME clusters in Indonesia. Strong concentrations in spatial distributions in which areal units and their neighbors, or hot spots, are found in Banten, DKI Jakarta, Jawa Barat, dan Central Java (shown by red colour in Figure 7). These regions have not only high growth of LME employment but also bring high regional spillover. On the other hand, cold spot region in Indonesia is found in South Sulawesi (shown by blue colour in Figure 7). It implies that the province has relatively low spatial clusters and regional spillover.
Figure 6. Moran’s I and Scatter Plot of GrowthCap Indonesia

Figure 7. Gi growth cap of LME clusters in Indonesia
Source: Calculated from BPS

2. Why LME tended to cluster in some regions?
To address this question, we test a discriminant model as specified in equation 1. Overall, our discriminant model allocates correctly more than 80.7% of the original group cases. Table 3
provides a classification summary for the model, which incorrectly allocates only 65 districts out of 326 to non-industrial districts. In terms of industrial districts, the model fails to allocate just 10 cases. As a result, the correctly predicted group membership is 80.1% for non-industrial districts and 84.1% for industrial districts.

<table>
<thead>
<tr>
<th>Table 3 Classification results$^a$</th>
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<tr>
<td><strong>Original Count</strong></td>
</tr>
<tr>
<td>%</td>
</tr>
<tr>
<td>0</td>
</tr>
<tr>
<td>1</td>
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<tr>
<td>0</td>
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<td>1</td>
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Note:
$^a$ 80.7% of original grouped cases correctly classified.
$^b$ $D_k$ is 1 for industrial district; 0 for non-industrial districts.

The results of a direct discriminant function analysis using seven predictors suggest that population density play a key role as the best predictor in discriminating LME between industrial districts and non-industrial districts (Table 4). The coefficient for this variable shows a positive sign. This implies that the higher the population density in a district the more likely that LME will cluster towards industrial districts. Figure 8 shows there are positive association between industrial density and population density across regions in Indonesia.

<table>
<thead>
<tr>
<th>Table 4 Discriminant function coefficients</th>
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<tr>
<td><strong>Predictor</strong></td>
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<tr>
<td>Population density</td>
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<tr>
<td>Income per capita</td>
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<tr>
<td>Skilled workers</td>
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<tr>
<td>Revenue sharing funds</td>
</tr>
<tr>
<td>Infrastructure</td>
</tr>
<tr>
<td>Productivity</td>
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<td>Average wages</td>
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</tbody>
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*Pooled within-groups correlations between discriminating variables and standardised canonical discriminant functions. Variables ordered by absolute size of correlation within function.*

Population density, regional income per capita, and skilled workers show positive coefficients. The positive coefficient of population density and income per capita show that both scale economies and large market size explain regional localisation over time that attract LME to locate in the industrial clusters. The findings confirm the prediction of New Trade Theory and New Economic Geography: scale economies and home market do matter (Kuncoro, 2012; Krugman, 1991; Fujita and Venables, 1999). These results suggest that LME manufacturing firms in Indonesia seek to locate in more populous and densely populated areas to enjoy both localisation economies, which are associated with the size of a particular industry, and agglomeration economies, which reflect the size of market of a district, in a particular urban area.
Skilled workers, reflecting the availability of skilled workers, played an important role of LME clustering. The positive coefficient of skilled workers shows that the higher level of labour force education the higher possibility of LME to locate in the industrial clusters. The finding is line with Smith and Florida (1994) which examined that big cities has become a magnet for skilled workers to concentrate geographically in urban regions to seek jobs.

Revenue sharing funds as a central government transfer to regions reflect agglomeration forces through resource based industry as argued by neo-classical economists (Johns, 1985: 178-81). The negative coefficient of revenue sharing funds suggest that higher revenue sharing funds the lower the possibility to attract LME industry to locate in those regions. Known as rich resource based regions, East Kalimantan, Riau, Aceh, Bangka Belitung are provinces that enjoyed higher revenue sharing funds. However, only mining companies, rather than LME manufacturing, that clustered in those provinces.

The infrastructure and productivity are also found as good predictors. The positive sign of infrastructure coefficient suggests that the better infrastructure availability in a region the greater possibility of LME to cluster in the region. The theoretical and empirical literature on agglomeration economies and urban public infrastructure pinpoints that agglomeration economies exist when firms in the urban areas share public goods as inputs to production (Ebers and McMillen, 1999). The finding is in line with Fujita et al. (1999: 233-236) and Krugman’s (1991) argument. The former argued that a hub or a port city provide the city’s site with an advantage over other sites, while the latter shows that reducing transport costs causes agglomeration.
Likewise, the positive sign of productivity coefficient means that the higher LME productivity will lead the LME to cluster in and around industrial districts. This findings support Porter’s (1998) theory that industrial districts constitute more productive industrial organization than non-industrial districts.

Wages are one of the important variables in labour economics but play as the least predictor in discriminating between LME industrial districts and non-industrial districts. The negative coefficient of wages shows that the higher wages the lower the possibility to attract LME industry to locate in those regions. We found that increase in wages will discourage LME to cluster in industrial districts. This finding supports Kuncoro’s (2007, 2012) argument that wages are important in the textile, wood and miscellaneous industries but turn out to be a less important variable in more modern LME industries such as machinery, chemical, and paper. Our findings suggest that higher wages in the industrial districts will encourage LME to expand and seek other districts offering lower wages.

V. Conclusions

Although a number of economists and business strategists have recently become more interested in spatial analysis, very few has examined the phenomena of regional clustering in Indonesia using provincial and district data simultaneously. Some studies focus on urban agglomeration, while others relate clustering to the competitive advantage of firms (Anselin and Florax, 1995; Enright, 1998; Hill, 1997; Krugman, 1995; Lucas, 1988; Porter and Solvell, 1998). This growing awareness on the spatial aspects of economies, the theoretical insights that have been developed are as yet little tested empirically.

Our study sought to inject empirical content to the emerging interest in the literature by examining regional clustering in the context of Indonesia’s recent industrial transformation. Using a GIS and recent perspectives in the literature of cluster, our study demonstrates that Indonesia represents an excellent example of both the uneven geographic distribution of manufacturing industry and the relationship between urbanization and industrial development. Indonesia contains many regional clusters within a fairly homogeneous economic and regulatory environment.

Indonesia’s rapid industrial and regional development during the last two decades has been heavily biased towards the densely populated island of Java. This is most striking in the case of LME manufacturing, corresponding with the modern sector of manufacturing. The predominant activities in Java can be explained as follows. First, historically during the course of the nineteenth century, the core of both the modern state and economy was moulded on Java, with the development of the plantation economy under the Cultivation System (Dick, 1996). Second, the spatial pattern can be quite readily explained by the attraction of labour- and skill-intensive industries to the heavily populated Java, compared with the attraction of resource-based industries to the Outer Islands (Kuncoro, 2012; 2013).

This study confirms that the LME industrial clusters are associated with urban concentration in Indonesia. Important distinguishing features of the industrial district have been identified by a discriminant analysis. The results suggest that the best predictor was population density, followed by income per capita, skilled workers, revenue sharing funds, infrastructure, productivity, and averages wages. Thus, LME in industrial districts differ statistically from the rest of Indonesia in terms of those key variables.

The Indonesian government has given attention to clustering perspective in the new National Industrial Policy and MP3EI recently (Kuncoro, 2007, 2013). As pointed out by Minister of Industry and Trade, the benefit of industrial clusters is to encourage product
specialisation and to change comparative advantage into competitive advantage (Kompas, 2000; Kuncoro, 2012). In line with this policy direction, understanding the locations, causes, and consequences regional clustering is imperative. This study serves as a valuable input to the government in formulating the new direction for industrial policy.

References


