Spatial agglomeration, firm productivity, and government policies in Indonesia: concentration and deconcentration in the manufacturing sector

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10 chapter

This chapter focuses on two of the three central themes of *World Development Report 2009*, namely, spatial concentration (density) and industrial decentralization (distance). Spatial centralization of resources and spatial concentration of economic activities in a few of the largest metropolitan areas are issues facing many developing countries. Concentration will bring spatial disparities between leading and lagging regions, widening gaps in living standards and welfare, and negative externalities associated with very large urban areas, such as congestion, crime, and pollution. From the standpoint of economic efficiency, of course, there are benefits from such concentration or agglomeration.[1] The challenge is to minimize the unintended negative effects. One solution is regional or territorial development within countries, which means encouraging the development of alternative centers in lagging regions.

Using series of firm-level data for Indonesian manufacturing, this chapter illustrates how the concentration took place as the economy was becoming more developed and how public policies could mitigate the problem by mixing infrastructure development in lagging regions with private incentives to encourage industries to concentrate in smaller cities in lagging regions. The government has made it possible for manufacturing firms to locate in outlying locations by building and improving roads in rural areas. The goal is to decentralize jobs to small cities and thus ease the pressure on large cities. During the 1980s and 1990s, efforts to decentralize manufacturing firms to outlying locations in Java were relatively successful mainly because localization forces were stronger than urbanization forces. The forces of decentralization pushed toward deconcentration, while local agglomeration and specialization encouraged industries to reconcentrate in smaller, medium-size cities. In the following sections, this chapter presents empirical evidence to explain why this was the case.

Evolution of the manufacturing industry's spatial configuration in Java

The concentration of economic activity in a few places is a common phenomenon. While the concentration of economic activity (and the concomitant economic efficiency) is itself desirable, the large spatial disparities in welfare associated with this process are mostly unwelcome. Manufacturing activities in Indonesia offer good examples of this process. In the Indonesian context, manufacturing, especially its labor-intensive branches, is instrumental in alleviating poverty. It provides millions of people with

more rewarding off-farm jobs and, at the same time, relieves pressure on agricultural wages. But the concentration of manufacturing in a few places in Java also attracts people to cities, putting severe pressure on overburdened urban infrastructure.

As in other countries, the Indonesian government has been eager to stem this tide by improving infrastructure, particularly roads, in the hinterland (Albala-Bertrand and Mamatzakis 2004). The social capital program, called INPRES, was created to improve infrastructure in the countryside. By investing in road infrastructure, the government made it possible for manufacturing firms to locate in outlying locations. In effect, the government attempted to move jobs to rural cities to ease the pressure on large cities. This chapter examines whether this policy was indeed successful in deconcentrating manufacturing out of old central locations.

For the purpose of comparison, all districts in Java are divided into high income per capita versus low income per capita regions (see table 10.1). As part of the Dutch colonial legacy, Jakarta (the capital city) and Surabaya (the capital of East Java province) were among the few places where manufacturing firms were originally concentrated (see figure 10.1). Naturally, the supporting service sectors, such as banking and trade, also agglomerated in those high-income regions.

Table 10.2 calculates the income gap between the national capital—Jakarta—and other cities and regions. Only Surabaya has been able to catch up with Jakarta, while others either have maintained the same gap (BOTABEK or Bogor, Tangerang, and Bekasi) or have fallen behind (low-income districts in lagging regions).

In terms of value added, the high concentration of manufacturing in regions with low income per capita is rather deceiving, because it is shared by about 83 (out of 97) districts, which occupy about 90 percent of the land area in Java (see table 10.3). Manufacturing firms in low-income regions are typically in food processing, mostly traditional food products. From 1986 to 2003, Jakarta lost its dominance as creator of value added, as its share of manufacturing gross domestic product (GDP) dropped to 19.3 percent in 2003. In the meantime, its neighboring districts, BOTABEK, increased their share to 23.9 percent. Evidently, some deconcentration took place, albeit relatively close to the old center. Surabaya showed some gains, while low-income regions suffered a loss of 6 percentage points.

Table 10.4 illustrates the role of the manufacturing sector in the local economy. The huge drop in the share of manufacturing in GDP in Jakarta reflects more than the movement from manufacturing to the service sector. The soaring costs of land, tighter environmental regulations, and worsening congestion have made it increasingly uneconomical for manufacturing to locate in Jakarta. The next-door neighbors of BOTABEK are the most logical sites. Using money from the oil boom of the 1970s, the government has made a conscious effort to improve road infrastructure in Java. Indeed, in contrast to Algeria, Ecuador, Nigeria, and Venezuela, Indonesia is the only oil-rich country in which agricultural output has expanded during an oil boom (Gelb and others 1988).[2] Although, from the infrastructure point of view, it was possible to relocate farther away from Jakarta, the choice of BOTABEK—about 60 kilometers from Jakarta—suggests that the national capital still acted as a magnet, drawing firms to locate in close proximity to it.

Why did the deconcentration happen so close to Jakarta rather than farther inland, for example, in Bandung, West Java, which is about 180 kilometers to the southeast of Jakarta? Infrastructure apparently was not the main reason. Indeed, road infrastructure in Java, which connects the industrial agglomerations of Jakarta and Surabaya

Table 10.1 Comparison of high-income per capita and low-income per capita regions in Java, select years, 1986–2003

GDP per capita in Rp million per year

Region	1986	1995	2001	2003
High income per capita regions				
Jakarta	1.4	8.9	28.7	36.2
BOTABEK	0.4	3.1	9.3	10.5
Lamongan, Gresik, Sidoarjo	0.5	2.6	6.9	8.7
Surabaya	0.8	5.8	18.0	23.0
Low income per capita regions	0.5	1.9	4.8	6.1

Source: Calculated from the regional income data of the Central Statistical Agency.

Figure 10.1 Java island and its vicinity

Source: www.lonelyplanet.com/java/.

Table 10.2 Ratio of local GDP per capita to Jakarta's GDP in Java, select years, 1986–2003

Region	1986	1995	2001	2003
High income per capita regions				
BOTABEK	0.32	0.35	0.32	0.29
Lamongan, Gresik, Sidoarjo	0.38	0.30	0.24	0.24
Surabaya	0.59	0.66	0.63	0.64
Low income per capita regions	0.34	0.21	0.17	0.17

Source: Calculated from the regional income data of the Central Statistical Agency.

Table 10.3 Spatial concentration of manufacturing GDP in Java, select years, 1986–2003
percent

Region	1986	1995	2001	2003
High income per capita regions				
Jakarta	26.2	25.2	19.3	19.3
BOTABEK	14.9	10.9	24.0	23.9
Lamongan, Gresik, Sidoarjo	4.9	8.7	6.9	5.0
Surabaya	4.1	6.5	5.0	7.1
Low income per capita regions	50.0	48.9	44.7	43.7

Source: Calculated from the regional income data of the Central Statistical Agency.

to the hinterland, improved a lot between 1986 and 1990 (see table 10.5).[3] The share of villages with paved roads in districts other than Jakarta, including those in low-income regions, increased significantly during this period. In this respect, Henderson and Kuncoro (1996), using the Java sample, suggest that, in 1986–90, centralization of the licensing regime in Jakarta was one factor drawing firms to central locations.[4]

Choice of firm location

This section examines firm-level decisions regarding location in the manufacturing sector. Conceptually, a firm will choose a location in which it believes it can earn the highest profit.

The trend of spatial concentration or deconcentration is presented in tables 10.6 and 10.7. Based on share of all firms as a simple measure of concentration, it appears that the trend among all industries between 1990 and 2003 was toward deconcentration (table 10.6). Despite a period of slight reconcentration between 1980 and 1990 as the nation underwent liberalization, the number of firms in Jakarta as a share of all firms dropped from 19 percent in 1980 to 11.5 percent in 2003. As expected, BOTABEK increased its share from only 5 percent in 1980 to 12.4 percent in 1990. Low-income regions, after experiencing a drop from 63.7 percent in 1980 to 57.4 percent in 1990, regained much of the loss in 2003, returning almost to the level in 1980. So from the firm-level standpoint, the deconcentration was of firms moving to lower-income regions.

This would have been almost impossible if the central and local governments had not improved infrastructure in Java, particularly roads (table 10.5).

At the outset, hinterland locations had difficulty attracting industries, despite government policies encouraging decentralization, such as the creation of industrial zones in outlying regions. Many industrial zones remained largely empty until the mid-1990s. Later on, after the second wave of economic liberalization in the mid-1990s, some deconcentration to areas farther from Jakarta did take place. Only after congestion and wage and price increases began to erode their competitiveness did firms start to fill in new locations adjacent to the original metropolitan areas of Jakarta, BOTABEK, and Greater Surabaya.[5]

At the industry level, the picture is more interesting. In terms of number of firms, as the economy was liberalized in the mid-1980s, textile firms began to concentrate in Jakarta and BOTABEK at the expense of low-income regions, particularly the old center of textiles in Bandung, West Java. But in 1995 this trend was reversed and continued until well after the economic crisis of the late 1990s. For machinery, the deconcentration took place mainly from Jakarta to the neighboring districts of BOTABEK and not much elsewhere. So, in effect, BOTABEK became a new center of agglomeration for machinery.

In the case of chemicals, low-income regions enjoyed significant gains, increasing their share of firms from 30.4 percent in 1980 to 45.7 percent in 2003. Tighter environmental regulations in urban areas may continue to force firms to relocate in less-regulated districts in low-income regions. However, this does not necessarily mean the reconcentration of industry, because these firms are shared by 83 districts. But new industrial agglomerations evidently are emerging in low-income regions, contributing to the increasing share of firms in these regions.

The nonmetallic industry has experienced deconcentration, mainly to low-income districts. The share of firms in lagging districts increased significantly, from 64.9 percent in 1980 to 83.5 percent in 2003, at the expense of Jakarta and BOTABEK. Districts in Gresik, Lamongan, and Sidoarjo enjoyed gains in other industries, but they were less significant than in the nonmetallic industry. Although less pronounced, the same picture can be observed for wood. Finally, there was little change in the concentration of food processing. There was movement between Jakarta and BOTABEK, but little movement elsewhere.

Table 10.4 Fraction of manufacturing value added in local GDP in Java, select years, 1986–2003

Region	1986	1995	2001	2003
High-income per capita regions				
Jakarta	0.54	0.21	0.22	0.22
BOTABEK	0.26	0.49	0.59	0.58
Lamongan, Gresik, Sidoarjo	0.30	0.33	0.35	0.33
Surabaya	0.23	0.35	0.34	0.34
Low-income per capita regions	0.13	0.17	0.21	0.19

Source: Calculated from the regional income data of the Central Statistical Agency.

Table 10.5 Fraction of villages with paved roads in Java, select years, 1986–2000

Region	1986	1990	2000
High-income per capita regions			
Jakarta	0.94	0.99	0.96
BOTABEK	0.31	0.61	0.72
Lamongan, Gresik, Sidoarjo	0.30	0.46	0.55
Surabaya	0.90	0.97	0.99
Low-income per capita regions	0.42	0.62	0.69

Source: Calculated from the village potential data of the Central Statistical Agency.

Table 10.7 presents the concentration of employment as a consequence of firm-level choice of location. As expected, the general picture resembles the concentration of firms in table 10.6. For machinery and nonmetallic minerals (including cement), where scale is important, the concentration of employment and any change associated with it is more pronounced than the concentration of firms in Jakarta and BOTABEK.

The movement of population

Industry concentration is measured by a normalized Hirschman-Herfindahl index. For each industry, the normalization controls for changes in industry concentration brought about by changes in population concentration over time. For industry j at time t, the concentration is given by:

$$g_j(t) = \sum_{i=1}^{I} = \left[\frac{E_{ij}(t)}{E_j} - \frac{P_i(t)}{P(t)} \right]^2, \qquad (10.1)$$

where $E_j(t)$ is national employment in industry j at time t, $P(t)$ is national population

Table 10.6 Concentration of manufacturing firms in Java, select years, 1980–2003

Region and year	Food	Textiles	Wood	Paper	Chemicals	Nonmetals	Machinery	All
1980								
High-income regions								
Jakarta	9.0	13.6	24.1	37.5	38.8	14.9	37.3	19.0
BOTABEK	2.9	2.3	4.5	4.2	11.7	9.2	9.3	5.0
Lamongan, Gresik, Sidoarjo	8.5	5.4	3.0	2.2	4.6	4.1	5.7	6.0
Surabaya	5.5	1.8	2.5	6.4	14.4	6.8	13.9	6.3
All leading regions	26.0	23.1	34.2	50.3	69.6	35.1	66.2	36.3
All lagging regions	74.0	76.9	65.8	49.7	30.4	64.9	33.8	63.7
All regions	100.0	100.0	100.0	100.0	100.0	100.0	100.0	100.0
1990								
High-income regions								
Jakarta	6.7	29.8	17.5	36.1	25.5	4.0	29.2	19.8
BOTABEK	5.2	8.7	20.0	12.5	23.9	11.5	22.8	12.4
Lamongan, Gresik, Sidoarjo	8.3	4.3	5.4	2.4	6.1	3.9	6.2	5.8
Surabaya	3.5	2.0	5.2	10.3	7.6	2.5	9.2	4.6
All leading regions	23.7	44.8	48.1	61.4	63.1	21.8	67.4	42.6
All lagging regions	76.3	55.2	51.9	38.6	36.9	78.2	32.6	57.4
All regions	100.0	100.0	100.0	100.0	100.0	100.0	100.0	100.0
1995								
High-income regions								
Jakarta	5.7	22.2	9.6	30.6	20.4	2.5	19.4	14.7
BOTABEK	7.1	13.1	15.9	16.9	25.8	12.0	31.1	15.6
Lamongan, Gresik, Sidoarjo	7.1	6.5	7.3	4.4	8.9	3.7	8.3	6.8
Surabaya	3.0	1.9	3.7	9.4	6.2	1.2	6.8	3.7
All leading regions	22.8	43.7	36.5	61.4	61.3	19.3	65.6	40.8
All lagging regions	77.2	56.3	63.5	38.6	38.7	80.7	34.4	59.2
All regions	100.0	100.0	100.0	100.0	100.0	100.0	100.0	100.0
2003								
High-income regions								
Jakarta	5.4	17.1	4.6	25.8	15.5	2.0	14.9	11.5
BOTABEK	6.5	10.8	10.8	16.5	24.1	8.0	34.3	14.5
Lamongan, Gresik, Sidoarjo	8.1	6.9	6.6	5.7	9.4	4.3	6.3	7.2
Surabaya	2.9	2.2	4.4	8.2	5.3	2.1	6.4	3.9
All leading regions	23.0	37.0	26.4	56.1	54.3	16.5	61.8	37.1
All lagging regions	77.0	63.0	73.6	43.9	45.7	83.5	38.2	62.9
All regions	100.0	100.0	100.0	100.0	100.0	100.0	100.0	100.0

Source: Calculated from the Central Statistical Agency, *Manufacturing Annual Survey* (various years).

at time t, and i is the total number of geographic units. The minimum value of $g_j(t)$ is 0; that is, when all locations' share of industrial employment is exactly the same as their share of population.[6]

The results are presented in tables 10.8 and 10.9. For simpler categorization, Jakarta is combined with BOTABEK to become JABOTABEK, while Greater Surabaya combines the city of Surabaya itself with the industrial districts of Lamongan, Gresik, and Sidoarjo. The Hirschman-Herfindahl concentration index for all industries confirms that overall manufacturing industries were more concentrated in 2003 than in 1990, which means that industrial concentration tends to deviate from where the population resides. In the booming period between 1990 and 1995, food and textiles became more concentrated, while other industries showed the opposite trend. Wood, chemicals, and machinery were highly concentrated in the beginning of the period, but afterward became significantly less concentrated.

For some industries, the 1998 economic crisis brought an abrupt change in the trend of deconcentration. Wood, chemicals, nonmetallic minerals, and machinery became more concentrated after the crisis. This reconcentration, however, was not a result of the influx of new firms; rather it was caused by the decline in the number of firms in outlying districts. This trend resumed in the post-crisis period of 2001–03. For all industries, the index increased from 3.1 percent (chemicals) to 35.1 percent (machinery),

Table 10.7 Concentration of manufacturing employment in Java, select years, 1980–2003

Region and year	Food	Textiles	Wood	Paper	Chemicals	Nonmetals	Machinery	All
1980								
High-income regions								
Jakarta	4.9	15.6	16.6	37.9	36.2	24.0	52.0	20.0
BOTABEK	1.3	9.8	8.2	8.4	15.0	13.3	9.2	7.3
Lamongan, Gresik, Sidoarjo	4.7	2.9	19.7	8.4	5.0	10.4	5.5	5.0
Surabaya	3.6	2.4	3.0	2.7	14.2	11.9	13.2	6.0
All high-income regions	14.5	30.7	47.5	57.5	70.4	59.6	79.9	38.3
All low-income regions	85.5	69.3	52.5	42.5	29.6	40.4	20.1	61.7
All regions	100.0	100.0	100.0	100.0	100.0	100.0	100.0	100.0
1990								
High-income regions								
Jakarta	4.6	19.0	11.1	29.0	20.1	14.1	32.8	17.0
BOTABEK	3.9	21.7	24.3	17.5	28.2	25.6	22.6	18.7
Lamongan, Gresik, Sidoarjo	5.0	1.9	10.8	11.4	8.7	6.8	5.0	5.2
Surabaya	4.0	1.1	6.0	6.5	6.6	5.9	12.4	4.7
All high-income regions	17.4	43.6	52.1	64.4	63.6	52.4	72.8	45.5
All low-income regions	82.6	56.4	47.9	35.6	36.4	47.6	27.2	54.5
All regions	100.0	100.0	100.0	100.0	100.0	100.0	100.0	100.0
1995								
High-income regions								
Jakarta	3.8	12.3	8.4	19.7	18.2	10.3	26.2	12.8
BOTABEK	0.4	1.1	42.0	9.7	1.0	17.4	4.4	1.1
Lamongan, Gresik, Sidoarjo	5.2	4.8	14.6	14.5	11.7	7.6	8.7	7.3
Surabaya	5.3	1.7	6.0	5.6	7.7	4.4	9.0	4.7
All high-income regions	20.3	47.7	49.3	58.2	64.1	53.5	77.7	48.1
All low-income regions	79.7	52.3	50.7	41.8	35.9	46.5	22.3	51.9
All regions	100.0	100.0	100.0	100.0	100.0	100.0	100.0	100.0
2003								
High-income regions								
Jakarta	4.5	12.1	4.0	14.1	11.9	6.4	19.5	10.8
BOTABEK	6.0	19.5	15.7	15.3	23.8	26.1	37.7	19.7
Lamongan, Gresik, Sidoarjo	6.3	4.3	10.8	17.1	11.0	10.3	5.7	7.1
Surabaya	7.2	1.2	4.6	5.6	4.3	5.9	6.6	4.2
All high-income regions	23.9	37.1	35.1	52.1	51.0	48.6	69.4	41.8
All low-income regions	76.1	62.9	64.9	47.9	49.0	51.4	30.6	58.2
All regions	100.0	100.0	100.0	100.0	100.0	100.0	100.0	100.0

Source: Calculated from the Central Statistical Agency, *Manufacturing Annual Survey* (various years).

Table 10.8 District industrial concentration index in Java, select years, 1990–2003

Industry	1990	1995	1997	2001	2003
Food, beverages, tobacco	0.027	0.050	0.022	0.027	0.029
Textiles, garments, leather, footwear	0.015	0.019	0.009	0.013	0.016
Wood and wood products	0.038	0.026	0.028	0.033	0.033
Chemicals	0.042	0.029	0.028	0.032	0.033
Nonmetallic minerals	0.037	0.030	0.033	0.049	0.054
Machinery	0.061	0.051	0.046	0.077	0.104
All industries	0.019	0.017	0.017	0.026	0.023

Source: Calculated from the Central Statistical Agency, *Manufacturing Annual Survey* (various years).

a significant increase in just over two years (see table 10.9). This suggests that, for those particular industries, the spatial distribution of firms and population deviated from each other. This can be attributed to the movement of new firms to central locations, but this is highly unlikely in the post-crisis atmosphere. It is possible that outlying districts in Java experienced more firm death or exit than central locations. It is also possible that population or workers moved to "cheaper" districts adjacent to JABOTABEK and Greater Surabaya and spent more time commuting to their workplace. Actually,

Table 10.9 Change in the district industrial concentration index in Java, 1990–2003
percent

Industry	1990–95	1995–97	1997–2001	2001–03
Food, beverages, and tobacco	85.2	–56.0	22.7	7.4
Textiles, garments, leather, footwear	26.7	–52.0	44.4	23.1
Wood and wood products	–31.6	7.7	17.9	0.0
Chemicals	–31.0	–3.4	14.3	3.1
Nonmetallic minerals	–18.9	10.0	48.5	10.2
Machinery	–16.4	–9.8	67.4	35.1
All industries	–10.5	0.0	52.9	–11.5

Source: Calculated from the Central Statistical Agency, *Manufacturing Annual Survey* (various years).

Table 10.10 Annual growth of stock of firms and labor employment in large and medium manufacturing enterprises in Java, 1990–2003

Period	JABOTABEK and Greater Surabaya	Java
1990–97		
Stock of firms	4.0	4.6
Labor employment	8.4	7.2
1997–2001		
Stock of firms	0.2	–0.9
Labor employment	1.8	1.7
2001–03		
Stock of firms	–2.6	–2.4
Labor employment	–1.4	–2.2

Source: Calculated from the Central Statistical Agency, *Manufacturing Annual Survey* (various years).

there was a slight decrease in the share of population living in both central areas, from 23.6 percent in 1995 (using intercensal data for 1995) to 22.9 percent in 2000 (using the 2000 population census).

What is interesting is that the concentration of all industries fell 11.5 percent between 2001 and 2003 (table 10.9). The category "all industries" includes paper, printing and publishing, and "other" categories. Taking into account all industries in all districts, the deviation between industrial and population concentration is not great, compared with the situation in which just a single individual industry is considered.

The puzzling question pertaining to the post-crisis increase in industrial concentration is resolved by figures presented in table 10.10. In the pre-crisis era, between 1990 and 1997, each year the stock of firms grew 4 percent for JABOTABEK and Greater Surabaya and 4.6 percent for the whole of Java. This implies that some deconcentration did take place. But in the post-crisis era, these figures turned negative: −2.6 and −2.4 percent, respectively. Evidently, there was more firm death in the two central locations than in remote districts. But these central locations had a far larger stock of firms to begin with and thus could sustain higher losses, while outlying areas had a meager initial stock of firms, leaving them with almost nothing if only a very few firms disappeared.

Empirical methodology: externalities and firm decentralization

For government policies to succeed, it is important to understand the behavior of firms with respect to choice of location, particularly their behavior related to agglomeration externalities (Henderson and Kuncoro 1996; Mitra 1999).

Firm productivity is closely linked to overall changes in employment and productivity. Firms have the potential to capture efficiency gains from learning by doing as well as from increasing returns to scale due to specialization and mechanization (Romer 1990).

In the Indonesian context, one important question is which type of externalities is actually stronger. Whatever the form, externalities have important implications for urban development. If externalities are in the form of localization—which in dynamic form are often called Marshall-Arrow-Romer (MAR) externalities—smaller cities are more likely to specialize in just one industry or in closely connected industries. Spatially, this means that standardized manufacturing activities tend to locate disproportionately in smaller, specialized cities. Thus policies to decentralize industries from their historical agglomerations are more likely to succeed.

However, if the externalities happen to be urban in nature, an industry needs to find a location in a large, diverse urban environment. Such industries are more likely to be found in large urban areas.

A related question is whether externalities are mainly static or dynamic. If externalities are dynamic, past industrial development in cities will affect present productivity, because, over time, a particular location accumulates a large body of knowledge. The paradox for industrial location is that firms become more static—tied to a particular industrial agglomeration—and less willing to move to cities where historically a particular industry has never existed and where there is no built-up stock of knowledge. This section examines whether the pattern of concentration or deconcentration across industries in Java is consistent with the estimated externalities.[7]

The approach is to relate firm productivity as a function of local industry inputs and the external environment generating spillovers (Henderson, Lee, and Lee 2001). The equation for assessing local externalities is based on the firm production function with constant returns to scale technology. In the intensive form, the firm technology is represented by:

$$x_{hij}(t) = A[S_{hij}(t)], f[k_{hij}(t)], \qquad (10.2)$$

where $x_{hij}(t)$ is real value added per worker in firm h, in city i, in industry j, and in time t, and $k_{hij}(t)$ is real capital per worker. The function $f(.)$ represents firm technology based on the original—extensive form—production function $F(.) = f(.)L_{hij}(t)$, where $L_{hij}(t)$ is the number of workers.[8] To obtain the real value added, the nominal value added is divided by the wholesale price index at the appropriate three-digit industrial code for the relevant years. Firms' capital is constructed from the estimated market value of machinery and building. To convert this into real terms, the nominal values are deflated by the wholesale import price of machinery (including electrical machinery). S_{hij} represents the shift in the production function, which also includes measures of spillover externalities, time and industry dummies, and firms' characteristics that supposedly affect productivity, such as legal and ownership status (foreign direct investment or domestic investment).[9]

Localization (MAR) externalities are measured by total employment in the same industry in the same district. This measure is meant to capture interaction among firms within a district. Urbanization externalities are measured by a diversity index. For district i, for example, the index of diversity is:

$$g_i^s(t) = \sum_{j=1}^{J} \left[\frac{E_{ij}(t)}{E_i(t)} - \frac{E_j(t)}{E(t)} \right]^2, \qquad (10.3)$$

where $E(t)$ is total national manufacturing employment and $E_j(t)$ is total national employment in industry j. Meanwhile, E_i and E_{ij} are the corresponding local magnitudes. The measure of urbanization economies $g_i^s(t)$ has a minimum value of 0, where within a district, each industry's share of local manufacturing employment is exactly the same as its share nationally, so the district is completely unspecialized because its industrial composition merely copies that of the nation. At the other end, the maximum value of $g_i^s(t)$ approaches 2 for a district completely specialized in one industry, while at the same time national employment is concentrated in another industry. The higher is $g_i^s(t)$, the less diverse and the more specialized is the district.

In estimating equation 10.2, we use a log-linear form of technology and assume city, time, and individual fixed effects. We also introduce firm characteristics such as legal status, firm ownership, and age to control for the shift in production function due to individual effects. The estimating equation is:

$$\begin{aligned} \ln[x_{hij}(t)] = {} & \alpha_j + \beta_j \ln[k_{hij}(t)] \\ & + \delta_j \ln[E_{ij}(t)] \\ & + \gamma_j g_i^s(t) + \rho_j(t) \\ & + \eta_{hij} + \mu_{ij} + \varepsilon_{hij}. \end{aligned} \qquad (10.4)$$

The equation is estimated at the level of industry j. Localization externalities are represented by the district's employment in the same industry, E_{ij}. Urbanization economies are represented by the g_i^s index in the linear form.

For industry j, the error term comprises four components; time fixed effects, $\rho_j(t)$, which can be used to infer productivity gains; district fixed effects, μ_{ij}; individual firm fixed effects, η_{hij}; and contemporaneous errors, ε_{hij}, which are assumed to be i.i.d. Exploiting the nature of the data, in order to capture time fixed effects, we introduce time dummies for the relevant year of manufacturing survey. District dummies are introduced to capture district fixed effects. District fixed effects capture time-invariant aspects, which are perhaps unique to that particular location, such as resource endowment, climate, urban layout, and internal infrastructure.[10]

Results

Table 10.11 shows the results for textiles, a category that includes textiles, garments, leather, and footwear. The coefficient of the same-industry employment is positive and highly significant, reflecting strong localization economies. For the period before the crisis, the coefficient for urbanization is positive but insignificant. In the crisis period, the coefficient is positive and significant. It turns negative and significant in the post-crisis period, which means that firms located in more diverse environments have higher productivity. Because the sign of the coefficient of same-industry employment is always consistent, the forces of localization are stronger than the forces of urbanization. So textiles are more likely to be found in more specialized, smaller cities.

Chemicals encompass smaller subgroups of industries such as basic and industrial chemicals, petroleum refinery and products, and rubber and plastic products. The results for chemicals are presented in table 10.12. The coefficient of same-industry employment is significant before and after the economic crisis, but not in between. The evidence for the dominance of localization forces is quite strong, because the urbanization coefficient is never significant.

Table 10.13 reveals the results for nonmetallic minerals, a group consisting of glass products, ceramics, clay, cement, and other nonmetallic minerals such as marble and granite. Unlike textiles and chemicals, the evidence supporting localization is very weak or nonexistent, and the coefficients for the entire period are never significantly positive. The coefficients turn negative and significant after the economic crisis, which implies that firms go to where the presence of the particular industry is weak. The coefficient for urbanization is also weak: none of them is significant in three periods of analysis. So the category of nonmetallic minerals exhibits no clear pattern either in localization or in urbanization.

Table 10.14 shows the results for machinery. Unlike nonmetallic minerals, this industry consists of more uniform products, ranging from metallic products, nonelectrical

Table 10.11 Externality and productivity in Java: textiles, garments, leather, and footwear, 1990–2003
dependent variable: log value added per labor

Explanatory variable	1990–95	1997–2000	2001–03
Log of capital per labor	0.21**	0.27**	0.15**
	(9.67)	(10.34)	(6.47)
Log of same-industry employment (localization)	0.13**	0.03	0.19**
	(4.87)	(0.33)	(13.39)
Index of districts' diversity (urbanization)	0.67	9.04**	–0.70**
	(1.58)	(3.67)	(4.20)
Year dummies	Yes	Yes	Yes
District dummies	Yes	Yes	Yes
Firm characteristics	Yes	Yes	Yes
Constant	–0.35	–0.74	0.80**
	(1.21)	(0.55)	(4.03)
Number of observations	18,807	7,768	7,539
R^2	0.34	0.41	0.33

Source: Author's calculations.
Note: Numbers in the parentheses are *t*-statistics with robust standard errors.
** Significant at 5 percent.
* Significant at 10 percent.

Table 10.12 Externality and productivity in Java: chemicals, 1990–2003
dependent variable: log value added per labor

Explanatory variable	1990–95	1997–2000	2001–03
Log of capital per labor	0.32**	0.22**	0.23**
	(19.11)	(9.58)	(10.68)
Log of same-industry employment (localization)	0.22**	0.05	0.16**
	(3.05)	(0.35)	(2.01)
Index of districts' diversity (urbanization)	1.17	0.05	–1.52
	(1.48)	(0.35)	(1.18)
Year dummies	Yes	Yes	Yes
District dummies	Yes	Yes	Yes
Firm characteristics	Yes	Yes	Yes
Constant	–0.52	1.37	0.71
	(1.46)	(1.57)	(1.31)
Number of observations	8,642	5,144	3,464
R^2	0.35	0.41	0.27

Source: Author's calculations.
Note: Numbers in parentheses are *t*-statistics with robust standard errors.
** Significant at 5 percent.
* Significant at 10 percent.

Table 10.13 Externality and productivity in Java: nonmetallic minerals, 1990–2003
dependent variable: log value added per labor

Explanatory variable	1990–95	1997–2000	2001–03
Log of capital per labor	0.28**	0.32**	0.21**
	(14.01)	(5.93)	(5.81)
Log of same-industry employment (localization)	–0.17*	0.11	–0.26**
	(1.67)	(1.17)	(2.19)
Index of districts' diversity (urbanization)	0.19	1.20	2.26**
	(1.04)	(0.69)	(6.17)
Year dummies	Yes	Yes	Yes
District dummies	Yes	Yes	Yes
Firm characteristics	Yes	Yes	Yes
Constant	1.07	–0.10	2.56
	(1.36)	(–0.09)	(3.07)
Number of observations	6,858	3,975	3,121
R^2	0.54	0.43	0.72

Source: Author's calculations.
Note: Numbers in parentheses are *t*-statistics with robust standard errors.
** Significant at 5 percent.
* Significant at 10 percent.

Table 10.14 Externality and productivity in Java: machinery, 1990–2003
dependent variable: log value added per labor

Explanatory variable	1990–95	1997–2000	2001–03
Log of capital per labor	0.26**	0.29**	0.17**
	(17.10)	(10.61)	(9.89)
Log of same-industry employment (localization)	0.10	0.31	0.24**
	(0.98)	(1.27)	(5.66)
Index of districts' diversity (urbanization)	–65.52*	0.13	156.76**
	(1.82)	(0.07)	(12.69)
Year dummies	Yes	Yes	Yes
District dummies	Yes	Yes	Yes
Firm characteristics	Yes	Yes	Yes
Constant	1.07	–1.39	–0.36
	(1.36)	(–0.75)	(1.08)
Number of observations	8,151	3,996	3,675
R^2	0.30	0.32	0.31

Source: Author's calculations.
Note: Numbers in parentheses are *t*-statistics with robust standard errors.
** Significant at 5 percent.
* Significant at 10 percent.

machinery, electrical machinery, transportation, and scientific equipment. The forces of localization and urbanization are clearly nonexistent before and during the economic crisis. The coefficient of the same industry, though positive, is very weak statistically. The same also applies to the urbanization variable or the diversity index. Only later in the post-crisis years does the coefficient of the industry, along with the diversity index, become positive, which means that the previous districts in which the industry is found become even more specialized in the production of machinery.

Previously it was said that if an industry exhibits dynamic externalities, the past industrial environment in that particular location will affect the present-day productivity. Consequently, firms are reluctant to move to locations with no prior history of that particular industry. This makes it difficult for industries to deconcentrate from prime locations to the hinterlands. To address this concern, we estimate the dynamic version of equation 10.3. For this, employment in the industry and the diversity index are replaced by their relevant past value with a lag of five years. The model is tested for the 1990–95 period, when there was no huge economic shock. The results are presented in table 10.15. The lag of the same-industry employment is positive and significant for textiles and chemicals, while none of the coefficients of the diversity index or urbanization is significant. The results mimic the static model. So, potentially, nonmetallic minerals and machinery may have a better chance than other industries of deconcetrating further to outlying locations.

Conclusions

As commonly observed in other countries, in Indonesia as the economy was liberalized, economic activities tended to become more concentrated in a few places, which brought unintended negative externalities associated with agglomeration. This chapter illustrates how public policies interacted with private incentives to mitigate this problem. After experiencing a period of concentration, these policies were able to mitigate the concentration trend and to bring about distance from the initial, historical agglomerations, enabling industries to reconcentrate in smaller, less expensive cities, including those in low-income or lagging regions in Java.

Based on empirical exercises conducted on Indonesia's four most important industries, the chapter finds that this occurred because the nature of externalities and agglomerations favored industrial spillovers—that is, localization was stronger than urbanization effects. If externalities are in the form of localization, smaller cities are more likely to specialize in just one industry or in closely connected industries. However, if the externalities happen to be urban in nature, an industry will have to find a location in a diverse, large urban environment. The deconcentration process from Jakarta

Table 10.15 Test of dynamic externalities in Java, 1990–95

Explanatory variable	Textiles	Chemicals	Nonmetals	Machinery
Log of capital per labor	0.21**	0.32**	0.29**	0.27**
	(9.62)	(19.25)	(14.26)	(16.97)
Lag of log of same-industry employment	0.10**	0.10**	0.02	0.08
	(4.11)	(2.84)	(0.42)	(1.16)
Lag of index of districts' diversity	0.06	0.71	–0.28	–1.13
	(0.12)	(0.93)	(1.57)	(0.83)
Year dummies	Yes	Yes	Yes	Yes
District dummies	Yes	Yes	Yes	Yes
Firm characteristics	Yes	Yes	Yes	Yes
Constant	0.28	–0.39	–0.18	0.36
	(1.16)	(1.08)	(0.65)	(0.54)
Number of observations	18,636	8,480	6,818	7,980
R^2	0.34	0.35	0.54	0.30

Source: Author's calculations.
Note: Numbers in parentheses are *t*-statistics with robust standard errors.
** Significant at 5 percent.
* Significant at 10 percent.

and BOTABEK is very apparent in nonmetallic minerals and machinery industries, but it is less evident in textiles and chemicals, since their externalities are dynamic—that is, firms are less willing to move to locations without a prior history of the industry and hence no accumulated stock of knowledge.

Government policies were designed not to interfere with private incentives (that is, firms will always look for the most efficient sites in which to locate), but rather to complement them. Drawing from these lessons, the following measures could be implemented in the future:

- Improve our understanding of the behavior of firms in different industries, especially regarding their choice of location.
- Improve infrastructure in lagging regions. At the initial stage, the most effective policy is to improve or construct roads to cut the costs and time of traveling between factory sites and markets or ports. Although, at the outset, the relocating firm or new entrants may only be willing to move within close proximity of the old center, given enough time, they will gradually fill up sites farther away, as the initial ones become more congested.
- Decentralize the national licensing regime to local governments. This would allow firms, especially those that are the most reliant on the centralized bureaucracy for financing, export-import licenses, and other aspects of business, to locate closer to the national capital. Responding to this, in 1999 the legislature passed the Decentralization Law, which was subsequently enacted in 2001. Greater autonomy is delegated to around 400 districts in many areas, including in the fields of public works, health, education, agriculture, industry, trade, and environment. It is true a lot of problems have emerged since the launching of decentralization, such as the proliferation of new local taxes and local government corruption. However, these should be viewed as transitory problems, as the economy is moving to a new equilibrium.
- Construct basic infrastructure, such as village halls, schools, health centers, and markets. Such infrastructure is very important because it provides the basic services that the local population needs and wants, reducing the incentives to migrate (permanently) to cities and easing the pressures on urban areas. By locating in nonurban areas, firms can also meet their need for workers with various skill levels and keep jobs in local areas.

Notes

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1. One important benefit of agglomeration is that firms can learn from each other, creating a synergy that collectively boosts their average productivity. In this regard, there are two types of "positive" externalities. First is localization, in which firms learn about local inputs, output markets, and technological conditions in the same industry. Alternatively, firms learn from all firms in a city, where the diversity of local industries enhances the environment for local information. This type of externality is called urbanization or, in the dynamic context, Jacobs externalities (Jacobs 1969).

2. Not only roads but also village infrastructure, such as village halls, schools, health centers, and markets, were constructed in rural areas.

3. We use PODES (village potential) from various years to construct road indicators.

4. The influence was strongest for incorporated firms that were most reliant on the centralized bureaucracy of financing, export licenses, and other aspects of business. The economic liberalization in the mid-1980s gave firms better access to government and other centralized services; to take advantage of these opportunities firms had to centralize in close proximity to Jakarta because the bureaucratic process was centralized and communication was poor.

5. For example, Krawang and Cikarang in western Java, Kabupaten Semarang and Magelang in the Semarang-Yogyakarta corridor in central Java, and Pasuruan, Jombang, Mojokerto, and Lamongan in eastern Java (see figure 1). But they did not locate exclusively in industrial zones. Batam Island was not taken into account because it had special regulations regarding industry exclusively for export.

6. This happens when there is total deconcentration of industries in which employment in local industry is a fixed fraction of the local population in all cities. At the other end of the spectrum, when $g_j(t)$ approaches its maximum value of 2, an industry is totally concentrated in

one location, for example, at location k, such that $Ek_j(t)/E_j(t) = 1$, when population share is miniscule, or $Pk(t)/P(t) \rightarrow 0$, when population is concentrated in another location.

7. We focus on four industries; textiles, chemicals, nonmetallic minerals, and machinery. A study on manufacturing location in Indonesia looks at spatial concentration in Java, where about 80 percent of manufacturing firms are located. Another consideration is that the location's choice model is probably more applicable to Java because infrastructure, the quality of labor, and other amenities located in the outer islands are not really comparable to those in Java.

8. The reason for choosing value added instead of output is that the former is less susceptible to the extent of outsourcing and the use of same-industry intermediate inputs. At the aggregate level, this could overstate the true net industry output with magnitudes that vary by the diversity and size of the district, potentially biasing the estimate of true urbanization externalities.

9. In the empirical formulation, agglomeration effects are modeled as external to the firm. Hence we can assume a constant return to scale (CRS) technology for firms so the output can be written in terms of output per labor or productivity. This can be easily modeled as the impact of agglomeration on firm productivity. There is no contradiction between the use of CRS with increasing returns to economic scale: 100 firms can agglomerate in one location to create externalities, which is obviously different than when one CRS firm locates alone in a location with no externality, because nobody else is around.

10. To control for firm fixed effects, we employ several important firm characteristics available in the manufacturing survey, such as foreign direct investment (FDI) versus other investment, the share of capital equity ownership belonging to various entities such as the central government, local governments, private domestic investors, and foreign investors, and legal status.

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