



# Private Enterprise Development in Low-Income Countries

## Firm Clusters and Productivity in Indonesia

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*Examining how agglomeration, or clustering, among Indonesian manufacturing firms has changed over the past 30 years, we found that its most robust drivers have been natural resources and supply chain linkages, especially with respect to explaining long-term changes in spatial concentration. We also developed a new approach for estimating productivity spillovers across networks of firms, but we found that spillovers between manufacturers in Indonesia were significantly smaller than what has been observed in other countries.*

### Introduction

Throughout the world, one of the striking facts about economic geography is that firms and workers tend to cluster, or agglomerate, in certain places. Researchers have offered many different explanations for such spatial concentration, including lower transport costs, natural advantages, and productivity spillovers - that is, the fact that firms can be more productive simply by being located near other firms. These productivity spillovers can take many forms, including shared knowledge or technology spillovers, labour market pooling, and intermediate input linkages.

In both developed and developing countries, many governments spend considerable resources to encourage firms to cluster in certain locations. However, the nature of agglomeration and the relative importance of these different drivers of agglomeration are not well understood, particularly in developing countries. In order to design and implement effective cluster-based policies, we need a better understanding of how and why firms cluster and whether there are positive spillovers from clustering.

We study the location decisions of large manufacturers in Indonesia, and investigate whether the dramatic political changes in Indonesia over the last 30 years led to changes in the spatial distribution of economic activity. We then develop a new strategy for identifying productivity spillovers between firms, and apply this strategy to identify how a firm's productivity is affected by shocks that do not affect the firm directly but affect firms that are located in the same geographic location or industry.

### Policy context

Indonesia represents an interesting test case for examining theories of spatial concentration. Because of its unique geography as an archipelago, colonized by the Dutch, spatial inequalities in the concentration of economic activity, employment, and output have been a central feature of Indonesia's economy for centuries.

General Suharto assumed the presidency in 1967, ultimately ruling Indonesia as a dictatorship for over 30 years as one of the strongest and most centralized governments in Southeast Asia. Suppressing separatism in the Outer Islands, often through violent means, was an important feature of Suharto's New Order regime. However, reducing regional inequality was also a central goal of government policy during the Suharto era. The government pushed several flagship development programmes, including large-scale population resettlement from rural Java/Bali into new agricultural settlements in the Outer Islands, mass primary school construction and water and sanitation infrastructure in lagging regions, block grant transfers to underdeveloped villages, special economic zones, and road construction efforts. During



## Private Enterprise Development in Low-Income Countries

Suharto's reign, Indonesia experienced rapid economic transformation, growing from one of the poorest countries in Asia to one of the emerging Tigers.<sup>1</sup>

However, the tremendous economic progress during the Suharto era came to an abrupt and grinding halt with the Asian Financial Crisis in May 1997 and ensuing political turmoil. In the wake of the upheaval, Indonesia ushered in a new democratic political system with far-reaching institutional reforms. With democracy in place by 1999, the government also embarked on sweeping decentralization reforms beginning in 2001, with district governments becoming more powerful and exerting much greater control over local policies than ever before.

### Methodology

We began by constructing two measures of industrial concentration - the seminal measure proposed by Ellison and Glaeser (1997) and a more continuous measure suggested by Duranton and Overman (2005). We applied these measures to two different datasets: (i) the Annual Survey of Manufacturing Establishments (*Survei Tahunan Perusahaan Industri Pengolahan*, or SI), which aims to be a complete census of manufacturing plants with 20 or more employees, and (ii) Indonesia's 2013 Directory of Manufacturers (*Direktori Industri Manufaktur*, or DIM), which contains address-level information for the headquarters of nearly 23,000 manufacturing plants in 2013 with more than 20 employees. We then related the levels and changes in spatial concentration to industry characteristics in order to better understand what led firms to cluster together.

Figure 1, Panel A, shows the locations of all 22,000+ manufacturing establishments in the DIM. Panels B and C of this figure also show the locations of establishments in two illustrative industries: wood, bamboo, or rattan furniture production (Panel B) and cooking oil manufacturing (Panel C). Each dot on the maps displays the location of a single establishment. Wood furniture production (Panel B) exhibits a significant propensity for clustering. Several centres of production are readily apparent, including those in and around Jakarta, in several cities in Central and East Java, and also in southern Bali. There are also very few wood furniture manufacturers outside of Java and Bali. On the other hand, the locations of cooking oil processors (Panel C), which includes palm oil and coconut oil, are much more diffuse. This is due in large part to the wide geographic scope of the key resource inputs to production, which, in the case of palm oil, must be processed within a day or two of harvest. Moreover, cooking oil production is less capital intensive, and agglomeration economies in cooking oil production are plausibly less important.

To measure the industrial and geographic connections between different firms over which productivity spillovers may diffuse, we used data on the different products that industries produce and use as raw materials to construct a network of forward and backward linkages. We then created a family of firm-level networks by assuming that firms are connected to one another if they are in the same industry, if their industries are related to each other through forward or backward linkages, or if they are located in close physical proximity.

The resulting network of firms allowed us to identify productivity spillovers by examining shocks to firms that are linked through the network structure, but only indirectly - what we refer to as "neighbours-of-neighbours". For example, suppose that Firm A and Firm B are in different cities, but are linked because Firm B provides inputs to Firm A. Suppose that Firm C is located in the same city as Firm B, but is not linked to Firm A. A shock to Firm C would affect Firm C's productivity; it could also affect Firm B's productivity (since B and C are located in close proximity) and, through the shock to Firm B, could indirectly affect Firm A.

<sup>1</sup> The term indicates countries that experience a rapid economic growth. Originally the Asian Tigers where four – South Korea, Singapore, Hong Kong and Taiwan – and where later followed by other five countries – Indonesia, Malaysia, Thailand, Vietnam and the Philippines.



# Private Enterprise Development in Low-Income Countries

**Figure 1: Locations of firms in Indonesia – selected industries**  
**(A) 22,000+ Establishments in 2013**



**(B) Furniture (wood, bamboo, or rattan) (ISIC 3321)**



**(C) Manufacture of cooking oil (ISIC 3115)**



Source: DIBS (2013) and authors' calculations.

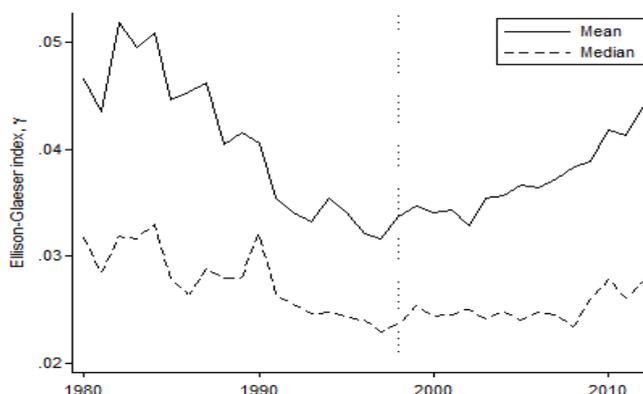
## Private Enterprise Development in Low-Income Countries

In other words, we identify productivity spillovers by examining how shocks to firms that are indirectly related to a given firm affect its productivity. We use changes in industry-level exchange rates as the external shocks in our analysis.

### Main findings

Figure 2 shows how the mean and median of the Ellison and Glaeser spatial concentration index evolved across industries over time in Indonesia. Strikingly, in 1984, the mean and median in Indonesia are identical to the mean and median that Ellison and Glaeser find for the U.S. in 1987. There was a sharp 40 percent reduction in the index for the average industry between 1984 and 1997. After the fall of Suharto, the average concentration index begins to rise, and by 2012, the index was back to its levels in the mid-1980s.

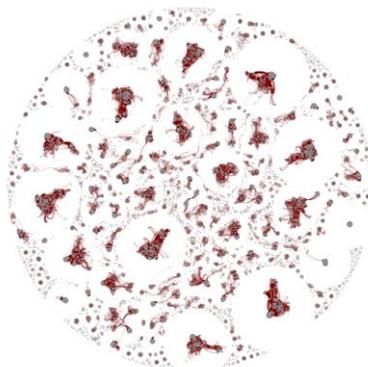
**Figure 2:** Trends in special concentration across industries



Source: SI data and authors' calculations. These figures plot the mean (and median) of Ellison & Glaeser's (1997) index at the district level over 4-digit industries with at least 10 firms per industry.

The increase in concentration after the fall of Suharto is somewhat puzzling. The political economy literature argues that because firms are incentivised to locate close to sources of political power, dictatorships tend to increase spatial concentration, so when they fall, we would expect spatial concentration to decrease. This force for greater dispersion should have been amplified by the process of decentralization. However, another possibility is that the fall of Suharto increased uncertainty and weakened the government, thereby increasing the returns to locating in the capital and exerting resources to support favourable legislation or policies. There was significant uncertainty about the direction of politics in the years after Suharto, and firms may have located in central cities in order to influence the direction of politics to their advantage.

**Figure 3:** Network of Firms ( $G^U(s = 0.01; d = 0)$ )



Source: Authors' calculations where connections arise for all firms within the same district ( $d = 0$ ) and/or at least 1 percent of shared inputs ( $s = 0.01$ ). Visualization uses the force-placement algorithm of Fruchterman and Reingold (1991).



## Private Enterprise Development in Low-Income Countries

We also examined the correlations between levels and changes in spatial concentration, and industry characteristics, in order to better understand the mechanisms leading firms to cluster together. We found that the most robust drivers of agglomeration were natural resources and supply chain linkages, especially with respect to explaining long-term changes in spatial concentration.

Figure 3 presents a visualization of the firm network linkages that we identified, using data from the year 2000. In 2000, there are 21,834 firms and slightly more than 1 million connections drawn between firms with clear clustering of firms not unlike other social network-based phenomena in the social sciences.

We found that exchange rate shocks have a meaningful impact on the productivity of “neighbours-of-neighbours”. We estimated positive average productivity spillovers between firms, but our estimates are substantially smaller than those found in the literature on U.S. and European firms. Moreover, the productivity spillovers we observe are driven by only a small number of industries. These relatively small estimates of productivity spillovers echo other work on agglomeration externalities in Indonesia.

### Potential policy impact

Our results show that spatial concentration in Indonesia exhibits similar overall patterns as spatial concentration in the United States and Europe. However, unlike in these countries, the concentration of skilled labour is not consistently correlated with agglomeration; rather, agglomeration in Indonesia is driven largely by natural resources and supply chain linkages. At the same time, we found that while there are productivity spillovers between manufacturing firms, they are small and are confined to a few industries.

Taken together, these findings suggest that one of the most important drivers of agglomeration externalities, knowledge spillovers, may not be operating well in Indonesian cities. To the extent that policymakers wish to encourage clustering among Indonesian manufacturing firms, it may be necessary to first address the underlying reasons for this lack of knowledge spillovers.

#### Moving Forward...

More research is needed to determine the reasons underlying the relatively small productivity spillovers we identified in Indonesia. Implementing our novel approach for identifying spillovers with firm-level panel data from other countries would allow us to cleanly study differences between productivity spillovers in developed and developing countries.

More broadly, this new approach is broadly applicable to estimating productivity spillovers in other contexts. Researchers with access to both input-output data, physical distance data, and firm-level panel data would be able to use this strategy in other contexts.