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Industrial Centralization in Indonesia

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In certain situations, economic liberalization policies can increase the degree of spatial centralization of resources and spatial concentration of manufacturing in large metropolitan areas. In addition, historical patterns of location make it difficult to alter the degree of centralization. This article explores these issues by specifying and estimating a nested logit model of industrial location of manufacturing activity in Java, focusing on the unincorporated sector. The results indicate that plants strongly prefer locations with mature plants in related industries, which offer a built-up stock of local knowledge. In addition, the 1983 liberalization in Indonesia was associated with increased centralization of the unincorporated sector. Although the liberalization gave unincorporated firms better access to government and other centralized services, firms needed to centralize to take advantage of these opportunities because the bureaucratic process is centralized and communications are poor. The relative increased growth of the corporate sector following liberalization may also have helped to further draw unincorporated plants into centralized locations.

Spatial centralization of resources and spatial concentration of manufacturing in a country's largest metropolitan areas are issues that many developing countries have been struggling with for two or more decades (see, for example, Renaud 1979, Hamer 1983, and United Nations 1993). The types of concerns represented in United Nations (1993) are widespread and representative. This report asks how bad "the negative factors associated with very large cities" need to get "before [it is in the] self-interest of those in control to encourage development of alternative centers." The same report warns of "unbalanced urban hierarchies" and congestion, crime, and social inequality in very large metro areas.

Although we do not necessarily subscribe to this view, it gives a motivating context for this article. We focus on two issues. First, in certain situations will economic liberalization policies work to increase significantly the degree of centralization and concentration? Second, for countries seeking to lower the degree of centralization, do historical patterns of location strongly and directly influence current patterns, making it more difficult to alter the degree of centralization?

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We examine these issues in the context of Indonesia, focusing on Java. Although the results are specific to Java, we believe the analysis is quite general, as are the implications of the results. The conditions in Indonesia affecting spatial centralization are not atypical. The switch in regimes which occurred in Indonesia in the early 1980s consisted of common liberalization policies. Under similar circumstances in other countries, we might expect similar responses to economic liberalization policies of similar construct. In addition, we expect the influence of historical patterns of location on current patterns in Indonesia to operate in the same fashion in other countries (see, for example, work on the United States in Henderson, Kuncoro, and Turner 1995).

Section I provides a contextual background on the manufacturing sector in Indonesia. It outlines the degree of centralization of resources in Indonesia and institutional aspects of the manufacturing sector. Section II discusses the factors affecting location choices and decentralization in the manufacturing sector in Java. Section III describes the data used in the analysis. Section IV specifies and estimates a model of industrial location of manufacturing activity in Java and identifies the most important issues affecting decentralization. Section V examines how the historical environment of a locality affects current location decisions. Section VI examines the effects of economic liberalization on centralization of industry. Section VII presents conclusions.

I. The Manufacturing Sector in Indonesia

In Indonesia between 1980 and 1990 the ten largest urban areas (those with more than 1 million people) grew at an average annual rate of 5.3 percent, led by Greater Jakarta at 5.9 percent. In contrast, the next 15 metro areas (those with populations of more than 200,000 but less than 1 million) grew at an average annual rate of 3.9 percent (World Bank 1993). Thus urban concentration increased in Indonesia, a situation that international agencies view as a problem (for example, World Bank 1989).

Indonesia's main island of Java contained 61 percent of the national population and 78 percent of adult full-time workers employed nationally in manufacturing in 1985. Java's population of more than 110 million lives on an island the size of Arkansas in the United States. On the positive side, between 1980 and 1985 population growth (12 to 13 percent) and manufacturing employment growth (26 percent) were the same for Java as for Indonesia as a whole. However, between 1980 and 1985 in Java the concentration of population and centralization of manufacturing increased. In the four main metro areas (Greater Jakarta, Bandung, Surabaya, and Semarang), population increased by 32 percent, and manufacturing employment increased by 51 percent.

There are three major categories of manufacturing firms in the Indonesian Census: government firms (*perum*), the equivalent of incorporated firms (PT/NV), and unincorporated firms (*perorangan*). In this study, we focus on the location decisions of firms in the private sector. The incorporated sector ac-

counts for 55 percent of nonfood manufacturing employment, and the unincorporated sector accounts for 34 percent. The unincorporated sector contains smaller plants, which tend to be less tied to government policy decisions, such as decisions affecting the financing of business activity by state banks or the granting of export and import licenses. In the unincorporated sector we include all plants that operate with a permit. Home producers (without a permit) and a small group of tiny firms operating illegally (without a permit) are excluded. Basically, the unincorporated sector covers virtually all private manufacturing activity that has a separate place of business (and is unincorporated). We break down firms in the unincorporated sector into notarized proprietorships and non-notarized firms. Notarization conforms to European concepts and indicates a more formal business place, whose proprietors have more secure titles to their assets. Non-notarized firms tend to be smaller and more informal.

The Location of Firms in Java

Table 1 reveals the radical difference in the locational patterns of the incorporated and unincorporated firms in Java. Although table 1 reports employment figures, the relative figures for the number of plants are almost identical. With great consistency across the two-digit sub-components of manufacturing, 86 percent of corporate employees work in plants in a *kabupaten* (a district or county) whose center is within 50 kilometers of the center of one of the four major metro areas in Java. In contrast, and again with considerable consistency,

Table 1. *Percentage of Nonfood Manufacturing Employees Working in Centralized Plants, Java, 1985*

Industry	*All plants*	*Corporate sector*	*Unincorporated sector*		*Government sector*
			Notarized	*Non-notarized*	
Textiles	71	85	59	57	37
Furniture and wood products	50	87	43	30	46
Printing, publication, and paper	76	80	63	61	75
Chemicals	76	79	72	61	61
Nonmetallic minerals	65	91	35	32	66
Machinery	84	94	63	40	86
Miscellaneous manufacturers	60	86	46	48	75
Total nonfood manufacturers	69	86	56	44	59
Average firm size (number of employees)	—	208	40	8	271

— Not calculated.

Note: Centralized plants are those located within 50 kilometers of one of the four major metro areas in Java.

Source: Authors' calculations.

only 49 percent of employees in the unincorporated private sector work in plants within 50 kilometers of one of the four major metro areas. Within the unincorporated sector, centralization is higher (56 percent) for the larger notarized firms than for the non-notarized firms (44 percent) and is higher for some industries (chemicals and machinery); but, overall, the unincorporated sector remains much more decentralized than the incorporated sector.

What explains these differences in the location of plants for incorporated firms compared with that of unincorporated firms? It is not simply plant size differences or differences in the extent of government ownership. Within any category, plants nearer metro areas tend to be somewhat larger. If we control for plant size, however, the locational differences remain. For plants with 50 to 100 employees, for example, 88 percent of corporate sector employees and only 61 percent of the notarized unincorporated firms are in the 50-kilometer radius. Government participation in ownership does not explain the difference; virtually all workers in the unincorporated sector work in plants that are 100 percent privately owned. In the private corporate sector, 22 percent of employees work in plants where government participates in ownership. About 90 percent of employees in those plants work within the 50-kilometer radius, compared with 85 percent of employees in corporate plants that are entirely private.

An important difference between incorporated and unincorporated firms affecting location patterns is that the corporate sector is much more export oriented. Because Java has relatively poor interregional freight transportation and containerization development, export-oriented firms have a strong incentive to locate in big coastal ports, rather than in lower-cost, medium-size cities, even for very standardized manufacturing products. By contrast, in industrial countries, standardized manufacturing tends to locate in small and medium-size cities because land rents in medium-size cities are a fraction of those in metro areas and wage costs for skilled workers can be half or less than those in metro areas. But for big corporate firms to locate plants in hinterland cities, there must be good interplant communications and good transport to major export points, both of which are generally lacking in Java. Thus, the export-oriented corporate sector finds more centralized locations necessary. It is interesting to observe that in Java, recent major transport developments tend to be followed by massive relocation of corporate plants. For example, the government has extended toll roads from Jakarta east and west into the nearby Great Jakarta region (Botabek and beyond). Rapid and massive relocation and growth of corporate plants along the toll roads have occurred, as industry has moved out of the Jakarta urban area (DKI Jakarta) to the outskirts to take advantage of lower land costs and wages. Now over 75 percent of new corporate plants in the Jakarta region are established outside the main urban area (see Henderson, Kuncoro, and Nasution forthcoming).

Another feature that contributes to the centralization of corporate plants is the operations of the government and capital markets. Government in Indonesia is unusually centralized (World Bank 1989, 1993), including centralization

of regulation and licensing procedures of large (corporate) export-oriented plants. The banking system is also highly centralized. In the period from 1980 to 1985, Indonesian banking was dominated by state-owned banks that operated in a strict hierarchy of limits on loan sizes and categories, with smaller branches and branches in more remote locations having the strictest limits. Although an administrative hierarchy is not unusual in other countries, in Indonesia all applications for loans of a significant size must be pursued in Jakarta and can be approved only by the board of directors of the banks.[1] Basically, the system operates so that politically and socially connected applicants have the best chance of success at the lowest overall effective cost. Access to capital markets is thus much better for large centrally located firms. While such firms could keep that access and decentralize some production, poor intercity transport and communications make that difficult. Traditionally, unincorporated plants had little access to capital markets. In our data, for example, in one category of plant size (50 to 100 employees) the average loan size for capital expansion for corporate firms is 191 times that for unincorporated firms.[2] Of course, because part of the reason to incorporate is to better qualify for loans, this comparison of averages suffers from severe selection bias. But the biggest adverse impact of the strict banking hierarchy is likely to be on the single-plant unincorporated sector.

Decentralization of Private Unincorporated Firms in Java

Given the high and ongoing centralization of corporate firms within the overall context of Java, not much can be learned from studying their degree of decentralization. Later, we briefly present and review some results for the corporate sector from the appendix. Here we focus on how history and episodes of liberalization have affected decentralization of the private unincorporated manufacturing sector.

Can economic liberalization policies encourage centralization of resources? Indonesia presents an ideal place to pose this question. Starting in mid-1983, Indonesia undertook a variety of liberalization measures, including modest reform of export licensing procedures. The most dramatic reforms were in the banking sector. Public sector loans were made "competitively available" at market interest rates (Harris, Schiantarelli, and Siregar 1994), instead of being rationed and subsidized. In addition, restrictions on the private part of the banking industry were lifted, permitting rapid growth in this sector. Liberalization potentially opened capital markets to smaller, less well-connected firms in the unincorporated sector. However, liberalization may not have helped decentralization. Liberalization did not remove the administrative and spatial hierarchy in the loan process or the interpersonal nature of granting larger loans. To take advantage

1. Even in August 1994 the loan limit for the major government bank, Bank Rakyat Indonesia (BRI), was $0.5 million; applications for higher amounts had to be pursued centrally with the Board of Directors of BRI.

2. However, the sample size in our data is small—fourteen plants in each of the incorporated and unincorporated sectors getting loans, in that plant size category.

of liberalization in terms of obtaining significant size loans for capital expansion (beyond lines of credit), unincorporated firms would need to pursue loan applications and personal contracts in a few large metro areas. It seems that for a single firm effective access to large loans in the capital market would be greatly enhanced by centralized location.

In Java in 1983, there was a dramatic shift in the location patterns for all two-digit, nonfood, unincorporated manufacturing firms. This shift corresponds both to the date of the general announcement of Indonesia's liberalization and to some specific implementations in the financial markets. Data for aggregate employment in new plants in nonfood manufacturing are given in table 2. For the corporate sector there is some fluctuation but little overall shift from 1980 to 1985; on average, about 88 percent of employees in new plants located within the 50-kilometer radius of the four major metro areas during that period. For notarized firms in the unincorporated sector, about 52 percent of employees in new firms located in the 50-kilometer radius from 1980 to 1982 and 64 percent from 1983 to 1985. The jump is right at 1983, the year of the liberalization. For non-notarized firms, given their smaller size and inferred lower access to any credit market, the shift to more centralized new firms occurs a little more gradually. But again centralization increased sharply from an average of 43 percent of employees in new firms from 1980 to 1982 to 57 percent from 1984 to 1985. We infer that liberalization was responsible for the increase in centralization in the unincorporated sector. As with any regime switch, it is impossible to prove this causality. Later, nevertheless, we will further detail why we think the increased centralization was associated with liberalization.

We also note that the numbers for the unincorporated sector understate the overall shift in centralization. Between 1980–82 and 1984–85, the annual number of new firms increased by about 60 percent in the corporate sector and by only 35 percent in the unincorporated sector. Because more new firms in the corporate sector are centralized, the extent of overall increased centralization is understated by analysis based on new firms in the unincorporated sector.

Table 2. *Percentage of Nonfood Manufacturing Employees Working in Centralized Plants for Different Age New Plants, Java, 1980–85*

Year of establishment of plant	*Corporate sector*	*Unincorporated sector*	
		Notarized	*Non-notarized*
1980	94	48	42
1981	75	56	42
1982	94	52	45
1983	91	64	48
1984	91	64	55
1985	87	63	58

Note: Centralized plants are those located within 50 kilometers of one of the four major metro areas in Java.

Source: Authors' calculations.

Firms have responded to major decentralization efforts, such as widespread regional development of transport and communication facilities. The response to major infrastructure development in more distant hinterlands often seems slow, however. Evidence from other countries suggests that past patterns of industrial location tend to guide present patterns (see Hamer 1983 on Brazil and Lee 1989 on Korea). Plants in a particular industry tend to go to locations where there are already high levels of own-industry employment; own-industry employment is mature, or has been there for some time; and the existing industrial base is diverse. The literature suggests that history directly influences location, which is based partially on externalities, particularly dynamic externalities (Glaeser and others 1991; Henderson, Kuncoro, and Turner 1995). Dynamic externalities suggest a process of local knowledge accumulation (based on both local spillovers among firms and individual investments in knowledge), where today's local stock of knowledge (local trade secrets) about technology and about input and output market features and conditions depends on past levels of local own-industry activity. Altering current patterns of industrial location partly involves overcoming these conditions from the past, so that informationally deficit locations can compete with traditional locations for new plants. In Indonesia the problem may be heightened by the almost complete centralization of the corporate sector, which could draw in and hold unincorporated plants in central locations because of the positive externalities offered by the corporate sector. Although it may be easy for centralization to increase (for example, because of liberalization), the move toward decentralization to nontraditional locations may be harder.

II. Factors Affecting Location Choices and Decentralization

We divide the factors affecting the locational choice of nonfood manufacturing firms in Java into four categories, although the division for some variables is arguable. The categories are market conditions, the historical-industrial environment, infrastructure, and distance. We describe the conditions in 1980, which were those that new plants about to enter the market from 1980 to 1985 faced.

Market Variables

Local wage rates measure cost differences across *kabupaten* in hiring labor. For plants the relevant variable is the nominal wage rate because that is what they pay and what affects firm profits. For similar real wages across locations (nominal wages deflated by local costs of living), nominal wages vary by a factor of two or three in developing countries (see Henderson 1988) and by even a twofold factor in industrial countries. To measure the industry wage rate, we use total annual compensation divided by total paid employees in all firms existing prior to 1980 outside the industry. This represents a measure of the going manufacturing wage rate. It may be sensitive to local industrial composition, but we control for that in other variables (see next subsection).

The *kabupaten* population measures local demand for unincorporated firms. It affects the price at which these firms can sell their product and the proportion that can be sold locally without incurring significant transport costs. An alternative demand control would be *kabupaten* gross product, if available; but, relative to population, the gross product would be subject to great measurement error. Population is sometimes also used to reflect availability of certain market services and government services, but these phenomena will be represented by other variables here.

Industrial Environment

Each location offers potential plants a stock of local knowledge and a commercial environment of business services, suppliers, and buyers. The commercial environment can also be thought of as a stock variable established over time through accumulated location decisions made by public and private entities. Each location has a local body of knowledge about technology (Romer 1986), local adaptations of technology, potential suppliers and buyers, and location-specific aspects of the functioning of the bureaucracy (how to facilitate a license application in a particular *kabupaten*). Such knowledge is built up over time and represents a stock of local trade secrets about how to adapt technologies and operate in local markets. Knowledge appears in other studies to be highly localized and to diffuse slowly over space (Jaffe, Trajtenberg, and Henderson 1993). Empirical work suggests the presence of both static (see Henderson 1988 for a review) and dynamic externalities (for example, Glaeser and others 1991 and Henderson, Kuncoro, and Turner 1995). Although we cannot measure local knowledge, we can identify its likely determinants.

For a particular industry, information comes in part from other local plants in the industry; therefore the local industrial environment will be characterized first by the stock level of own-industry activity in that *kabupaten*. That is measured by 1980 employment in that industry as measured in the 1980 Population Census. The notion that plants in the same industry locally learn from each other and contribute to a common local knowledge base also explains why plants in the same industry cluster together spatially. So, typically, an industry has local specialization, whereby some locations have few or no plants and others have large clusters that enjoy positive externalities. However, plants also learn from other industries, such as other manufacturers. In fact, Jacobs (1969) argues that local diversity of economic activity is important for industry development—diversity encourages exploration and prevents stagnation by exposing local producers to a variety of techniques and ideas from outside their own industry. Thus, diversity of other manufacturers contributes to knowledge and could also provide Dixit-Stiglitz (1977) local-scale benefits from diversity and availability of intermediate inputs.

We measure local diversity (or, actually, lack of diversity) by the standard Hirschman-Herfindahl Index (HHI), equal to the sum of squared shares of employment by two-digit manufacturing industry in all other local manufacturing

employment. For any industry there are eight other manufacturing industries. If all other manufacturing employment is divided equally across two-digit categories, the HHI takes a minimum value of 0.125, indicating no concentration, or perfect diversity. As HHI rises, so does concentration, or diversity falls. HHI takes a maximum value of 1.0 when all other manufacturing employment is concentrated in just one two-digit component.

The maturity of the manufacturing environment may also matter, especially with a dynamic externality interpretation. Existing complementary (and even competing) plants that have a long experience may represent an advantage to new locators, relative to a situation where existing establishments are also inexperienced. Mature plants are better informed about persistent local supply conditions, local demand conditions, and the local institutional environment. New firms benefit by observing, to the extent feasible, how established firms operate in the local environment and deal with problems. Maturity of the environment is measured by an employment-weighted average of the age of all old manufacturing plants outside the own industry in the *kabupaten*, divided by the national average for each industry.

The measures of the local industrial environment detailed so far relate to aspects of manufacturing. A remaining key aspect of a local environment is the availability of business and government services. To capture that, we use diversity in one-digit activity. This variable is closely related to the extent of urbanization of the *kabupaten*. Variation in this one-digit diversity measure comes from swings in the extent of agriculture, with offsetting swings in services and commercial activity. Thus the one-digit diversity measure represents the extent to which an area is urbanized and offers business and government services, compared with a rural area that is deficient in services. For each of our two-digit manufacturing industries, when we calculate an HHI of all one-digit employment, we subtract the own- (two-digit) industry employment from the manufacturing and total employment measures in the index.

Infrastructure

Infrastructure as represented at the level of a *kabupaten* proved elusive to measure. In our data, *kabupaten* measures—such as length or percentage of all roads that are paved, percentage of houses served by telephone, and percentage of villages with phone service—are almost perfectly collinear with the percent of the population that is urbanized. The percentage of the population that is urbanized in turn is strongly correlated with the HHI for all one-digit economic activity. A high HHI represents an agricultural area; as HHI declines, services, retailing, and manufacturing increase relatively. We could not sort out these different effects, so we used the HHI for all economic activity to represent the extent of local development of general services (and urbanization) of the economy.

However, for electricity we have a measure that is not so collinear with indexes of urbanization: a measure of reliability of state Perusahaan Listrik Negara (PLN) service. First we note that oil is the energy choice in Indonesia when

technologies permit petroleum (internal combustion) power. Plants use electricity for lighting and for technologies that are usually driven only by electric motor. PLN service is widely available, but hook-ups and consistency are problems. Where service is poor, plants requiring electricity need a backup source. While electricity can be privately bought and sold, the data on consumption indicate most plants provide their own backup by installing their own generators. As an index of *kabupaten* reliability and availability of state service, we use the percent of existing plants in the *kabupaten* with a generator. There is considerable spatial variation in the consumption of plant-generated electricity (compared with PLN service) and in the reliance on and existence of generators. Traditionally, the more existing plants there are with generators, the less reliable the PLN service.

Distance

Distance is measured in 50-kilometer units of the straight-line distance from the center of a *kabupaten* to the center of the nearest of the four metro areas in Java. Although, generally, distance captures the transport costs of selling in the nearest national market center, here it has a more critical aspect. Distance, as well as possibly low population, may represent lack of access to the centralized banking system, to the centralized granting of export and import licenses, and to the centralized bureaucracy.

III. The Data

In considering the spatial allocation of resources in Java, we examine the location patterns of new nonfood manufacturing plants from 1980 to 1985, with liberalization occurring in mid-1983. We do not include food processing because it is based on the plantation system and regional peculiarities of food production (Hill 1987), which would deserve a separate study. We compare three years of data prior to liberalization (1980–82) with two years afterwards (1984–85). Although two complete years are not a long enough period for all basic responses to work themselves out, we can look for indications of a significant episodic shift in economic behavior after 1983.

Data on plants are taken from the plant-level data tapes for the 1986 Economic Census covering small, medium, and large plants, but not household production. Our sample includes all firms classified as private unincorporated—both notarized and non-notarized. Flows, or new plants, are defined as plants that started business between 1980 and 1985. Old plants are those still existing in 1985 that started business before 1980. Plants are classified at a two-digit level as defined in table 3, along with the major three-digit subcomponents for each two-digit industry. We also use the 1986 Economic Census to calculate wages, average age of old plants, and electrical generating capacity.

Data from the 1980 Population Census provide baseline (1980) characteristics such as *kabupaten* population, employment in different one-digit industries,

Table 3. *Industry Definitions and Coverage*

Two-digit category	*Some three-digit components*	*Share of three-digit component in two-digit category (percent)*
Textiles[a]	Textiles	68
	Apparel	25
Wood and furniture	Wood products	55
	Furniture (most wood)	45
Publishing and paper	Paper	33
	Printing and publishing	67
Nonmetallic minerals	Clay	14
	Cement	81
Machinery	Primary metals[b]	6
	Fabricated metals	35
	Machinery	9
	Electrical machinery	21
	Transport equipment	28
	Scientific instruments	1
Miscellaneous[c]	Sporting goods	16
	Toys, jewelry, and musical instruments	8
	Office equipment	13
	Other	64

Note: Indonesia divides manufacturing into nine two-digit categories. These two-digit categories are further subdivided into three-digit subcategories. We list the shares of major three-digit industries in the respective two-digit parent category.

a. Footwear and leather products are excluded from this analysis.

b. This is a small separate two-digit industry.

c. These subcategories represent aggregations of lower-digit activity.

Source: Authors' calculations.

and employment in two-digit manufacturing plants. Data from the 1980 PODES (Survey of Villages) measure geography (altitude, distance to coast, area) and phone service and roads in the *kabupaten*. We use price data from the 1984 SUSENAS (National Economic Survey on Household Expenditures) for instrumental variables.

We study industries in textiles, wood and furniture products, publishing and paper, nonmetallic minerals, machinery, and miscellaneous products. We exclude food processing and chemicals because the former is dominated by plantation activity, which is not our focus here, and the latter is dominated by the petroleum and rubber industries, which are under government or foreign control (Hill 1990). Our basic results on decentralization hold for chemicals also (Kuncoro 1994). This industry is just less sensitive to local market conditions than the other more free-market sectors.

IV. A Model of Industrial Location

In this section we present a model of locational choices by unincorporated firms for new manufacturing plants in Java. Unincorporated firms are unconstrained in locational choices, in the sense that, unlike the corporate sector, they have no noticeable government participation (partial ownership, representation on boards of directors) and have little or no foreign or overseas Chinese participation in ownership. We study decisions for new plants—the flows—as opposed to the historical decisions of the stock of plants. Estimates from this model will help us understand decentralization issues by quantifying the role of infrastructure investments, urban agglomeration, access to major metro areas, and history—the built-up and established industrial environment. These estimates in turn will allow us to start to assess the effect of regular industrial decentralization policies and of regime switches such as liberalization.

Locations are *kabupatens,* or roughly districts-counties, of which Java has 106. The *kabupaten* is a basic political unit from which allocations of infrastructure are made. Only a few metro areas are defined, beyond the area of a *kabupaten,* so doing a geographic division into cities is not feasible. However, our locational attributes will capture the level of urban sophistication of the *kabupaten.*

We focus on entrepreneurs' discrete choice of *kabupaten* in which to locate their plants. This choice is nested in entrepreneurs' discrete choice of industry. We need a framework that allows for discrete choices and also for different types of discrete decisions. A natural choice, which is computationally feasible, is the nested logit model. "First" entrepreneurs choose a two-digit manufacturing industry, and "then" they choose a geographic area for their plants. Because more than one plant from an industry may locate in a *kabupaten,* it is also possible to have a third level of nesting to test whether error drawings of plants in the same industry and geographic area are correlated. The whole model is specified and estimated in Kuncoro (1994). Here, although we discuss analysis of the other levels of the hierarchy, we focus on the middle level, looking at locational choices of plants by industry (that is, conditional on the industry chosen). Using these results, we then analyze the decentralization issues and further estimate the impact of regime switches such as liberalization.

The Econometric Specification

For the plant choice of location, the framework is related to standard work in Carlton (1983) and Lee (1989). Within an industry, plant j chooses location k from among M possible locations, if

$$\Pi_{jk}^{*} = \max[\Pi_{j1}, \Pi_{j2}, \ldots \Pi_{jM}] \quad j = 1, \ldots N \tag{1}$$

where Π_{jk} is the log of long-run profits associated with location k for plant j. In turn

$$\Pi_{jk} = \beta X_k + \varepsilon_{jk} \tag{2}$$

where X_k are locational attributes in linear, log, or dummy variable form at location k and ε_{jk} is an error drawing. Thus, plant j chooses location k if

$$\beta X_k + \varepsilon_{jk} \geq \beta X_\ell + \varepsilon_{j\ell} \text{ for all } \ell \neq k. \tag{3}$$

If the error terms are independent and identically distributed (iid) and distributed extreme value, then the probability P_{jk} that plant j locates in k is given by the conditional logit model where

$$P_{jk} = \frac{\exp(\beta X_k)}{\sum_{s=1}^{M} \exp(\beta X_s)} \tag{4}$$

In estimation, parameters of the model are only identified by imposing a normalization that the constant term be zero.

The iid assumption for error terms requires that plants choosing the same location do not have correlated errors in a nested logit setting, using the generalized extreme value distribution. Kuncoro (1994) tests for this and rejects the hypothesis of correlation for four of our six industries. But even for the other two, the correlation is very small.[3] The suggestion is that generally the X_k variables fully measure the relevant overall (or common) *kabupaten* characteristics facing firms choosing locations. The ε_{jk} can still measure site or neighborhood-village characteristics specific to the different intra-*kabupaten* sites that firms choose, where these are iid drawings.

In addition to the locational choice model, equation 3 has an upper level of nesting, where firms choose an industry on the basis of average profits for existing plants within the different industries, the standard deviation of profits across existing plants within an industry, and an inclusive value from the locational-choice nesting level. Kuncoro (1994) finds significant positive and negative coefficients, respectively, for the mean and standard deviation of profits, and an inclusive-value coefficient of 0.075 (the corrected standard error is 0.0023), suggesting a high level of correlation for a firm in the error drawings it faces across locations, given its industry of choice. Combining the upper- and lower-level nesting results, the implication is that error drawings are more related to specific unmeasured characteristics of the firm or entrepreneur (rather than overall *kabupaten* characteristics).

Given this background, we focus on locational choice for firms in different industries, conditional on industry choice. The implication is that these factors will also affect industry choices, as a second order magnitude.

3. With no plant-specific characteristics, the lower level nesting collapses to an inclusive value for our level of estimation of log N_k, where N_k is the number of firms choosing location k in the industry. In estimating equation 3, the coefficient on log N_k equals $1 - \rho$, where ρ is virtually the correlation coefficient for the plant error drawings within a *kabupaten*. For textiles, miscellaneous wood and furniture, and nonmetallic minerals, we cannot reject the hypothesis that $1 - \rho = 1$. For machinery and paper, $1 - \rho$ equals 0.91 and 0.88, respectively, with (corrected) standard errors of 0.029 and 0.045, respectively.

Estimation Issues

In constructing our variables explaining industrial location, to try to minimize potential endogeneity, we were careful to exclude own-industry and new-plant components for all measures. However, the results of the Smith and Blundell (1986) test for endogeneity of right-hand-side variables strongly suggested that, for all variables (except distance), endogeneity remains a critical problem (Kuncoro 1994).[4] Accordingly, we constructed a set of instrumental variables to use in the first stage of two-stage estimation of the logit model, so right-hand-side variables in logit estimation (except for distance) are predicted values from first-stage ordinary least squares equations. The idea is to use as instrumental variables in the first stage only truly exogenous measures (access to market centers, geographic area, distance to the coast, altitude, annual rainfall) or measures of prices and quantities from outside the own *kabupaten,* which are exogenous to the own *kabupaten.*

Quantities and prices in the own *kabupaten* are determined in a general equilibrium context, as influenced by the government's allocation across *kabupatens* of infrastructure, by nature's allocation of natural resources, and by contemporaneous error drawings. If prices or quantities are higher in other *kabupatens,* that affects the market and in particular government allocation of resources to the own *kabupaten.* For example, a *kabupaten* is more likely to have better roads if it is surrounded by more populous *kabupatens.* Given government allocation rules, the most influential *kabupatens* are contiguous to the own *kabupaten.* For instruments, we use the average for contiguous *kabupatens* of ten food price indexes (see Kuncoro 1994 for calculations) and wages. We also average quantities for contiguous *kabupatens* of altitude, coastal access, area, number of manufacturing households, population, and percentage of population that is urban and percentage with high school education. These variables give a reasonably high level of explanatory power to first-stage regressions for all right-hand-side variables. First-stage R^2s are all above 0.5 (most are in the 0.75–0.9 range) except for the maturity index for textiles, wood products, and paper; for HHI in manufacturing for wood products; and for wages and past employment in nonmetallic minerals. The lowest of these is 0.16 (maturity in paper) and the next lowest is 0.33.

Because of the two-stage estimation process, standard error estimates in the second stage (which uses predicted values of right-hand-side variables) are biased. Unbiased estimates are obtained by following the standard procedure (Murphy and Topel 1985) to fit our problem with seven endogenous right-hand-side variables in the logit equation for each industry. The calculations are given

4. This contrasts but does not necessarily conflict with the notion that the error terms for plants within a *kabupaten* are iid. The contemporaneous error terms for individual plants can each affect the right-hand-side variables but still be independent both in theory and conceptually. Conceptually, the ε_{jk} may reflect specific village-neighborhood conditions of the specific different sites where plants locate in the *kabupaten.* These can be iid; but these differing village conditions themselves influence overall *kabupaten* characteristics.

in Kuncoro (1994) and follow those in Pitt and Rosenzweig (1990). Although the computations are straightforward in concept, implementation in a problem of this size is extremely time consuming. The standard errors in table 4 are appropriately corrected, with an indication of the effect of the correction. The one-digit industry diversity measure for all economic activity is the most adversely affected. Results later in the article, showing the effect of experimentations to estimate the impact of regime switches or application to the corporate sector, have uncorrected standard errors.

Overview of the Results

The basic results for textiles, wood and furniture products, nonmetallic minerals, machinery, publishing and paper, and miscellaneous manufacturing are given in table 4. Here we analyze briefly the econometric results before turning to the interpretation of results as they relate to decentralization issues. Coefficients in table 4 are parameters of a normalized profit function (with a zero constant term). Profits are not the dependent variable per se, since the dependent variable is the discrete choice of *kabupaten* in which to locate. From these choices, given the functional forms specified, we infer the parameters of the profit function.

Coefficients of variables generally have the anticipated effects. Also, the impact of the two-stage work is generally as anticipated from related work (for example, Henderson 1988). In particular, wage variables are strengthened (coefficients switch from positive to negative), and so is the maturity index (negative coefficients switch to positive in isolating the age effect from competitive decentralization—new firms choosing new locations). Other variables that are sometimes "improved" in the direction of anticipated effects include past own-industry employment, HHI for manufacturing, and distance. The HHI for all industries is generally weakened (see Kuncoro 1994 for details).

MARKET AND INFRASTRUCTURE VARIABLES. Wages have a negative coefficient for five of the six industries and the population coefficients are always positive. Not surprisingly, coefficients on population (our local demand measure) are highest for products containing a large component of goods that are dependent on local markets and less traded across *kabupatens*—publishing (local print shops), textiles (apparel or tailored products), and nonmetallic minerals (building materials and clay pots). For the one reported infrastructure variable, the percentage of existing firms in 1980 with a generator, three of our six industries have a strong negative coefficient. The textile industry is of particular interest because it is so heavily dependent on electricity.

How do we interpret the coefficients in table 4? Since the estimates are normalized by setting the constant term in the profit function to zero, it is somewhat questionable to give a direct profit function interpretation to the coefficients. With such an interpretation for the variables in logarithms in table 4, the coefficients are elasticities of the profit function itself. Wage elasticities for sta-

Table 4. *Industrial Location for the Unincorporated Sector, Java, 1980–85*

Variable	*Textiles*	*Furniture and wood products*	*Nonmetallic minerals*	*Machinery*	*Publishing and paper*	*Miscellaneous*
Wages	−1.89	−0.381	0.088	−0.737	−0.071	−1.12
	(−3.96)	(−14.12)	(0.649)	(0.530)[a]	(−1.24)	(−1.92)
ln population	0.984	0.494	0.711	0.283	1.64	0.099
	(5.98)	(0.693)[a]	(3.48)	(1.83)[a]	(4.58)[a]	(0.165)
ln 1980 own-industry employment	0.368	0.246	0.265	0.129	0.0001	0.196
	(7.59)	(1.16)[a]	(26.24)	(19.25)	(0.576)	(5.82)[a]
HHI: manufacturing[b]	−2.97	−0.692	−1.44	−1.21	−0.314	−2.37
	(−1.75)[a]	(−0.509)[a]	(−28.31)	(−9.97)	(−6.52)[a]	(−30.48)
Maturity index: manufacturing[c]	0.441	0.952	0.705	0.444	0.431	0.477
	(4.93)	(8.04)	(33.25)	(0.847)	(0.018)[a]	(2.27)
HHI: all industries[b]	−6.25	−2.39	1.13	−2.75	−2.32	−6.51
	(−1.79)[a]	(−1.04)[a]	(0.903)[a]	(−0.266)[a]	(−1.66)	(−0.607)[a]
Percentage of existing plants with a generator[d]	−0.028	−0.009	−0.013	0.015	0.006	−0.007
	(−2.63)	(−0.824)[a]	(−7.19)	(0.507)	(0.169)	(−17.92)[a]
Distance[e]	−0.532	−0.333	−0.150	−0.482	−1.31	−0.584
	(−9.26)	(−0.270)[a]	(−12.48)	(−10.48)	(−22.79)	(−14.59)
Number of observations	4,857	3,574	4,297	1,460	756	693

Note: Coefficients are from logit estimation in which the dependent variable is the discrete choice of ***kabupaten*** in which to locate. *t*-statistics based on corrected standard errors are in parentheses. The correction has a consistent impact on the HHI indices, tending to reduce their significance level, especially for HHI: all industries.

a. Indicates a coefficient that switches from being significant to insignificant or vice versa, following standard error corrections, due to two-stage estimation.

b. The Hirschman-Herfindahl index (HHI) for manufacturing is a measure of diversity of manufacturers; it is the sum of squared shares of employment by two-digit manufacturing industry in all other manufacturing. The HHI for all industries measures local economic diversity. It is the sum of squared shares of one-digit employment in all employment.

c. Maturity of the manufacturing environment is measured by an employment-weighted average of the age of all old manufacturing plants outside the own industry in the ***kabupaten***, divided by the national average for each industry.

d. Existing plants are those in existence in 1985 that were established before 1980.

e. Distance is measured as the straight-line distance from the center of a ***kabupaten*** to the center of the nearest of the four metro areas in Java.

Source: Authors' calculations.

tistically strong coefficients range from −0.4 to −1.9, and population elasticities range from 0.3 to 1.6. These do seem like reasonable magnitudes. Below, in table 5, we will give an alternative interpretation of coefficients based on percentage effects on location probabilities.

INDUSTRIAL ENVIRONMENT. Past own-industry employment always has positive coefficients in table 4, indicating the positive effect of historical own-industry activity. It is statistically weakest for publishing and for furniture, corresponding to results in Henderson (1988), where these industries in the United States and Brazil are less affected by local own-industry scale. Other aspects of the industrial environment also conform to expected outcomes. The diversity of the surrounding manufacturing environment has a strong impact, where an increase in HHI for manufacturing, which is a *decrease* in diversity, always has a negative sign. Again, these effects are weakest for publishing and furniture. The maturity of the manufacturing environment also matters; more mature environments are better, in all industries. However, diversity of the general economic environment, which controls for urbanization and economic sophistication of the *kabupaten,* has no statistically significant effect, once standard errors are corrected. It does have expected negative signs with large coefficients in five of the six industries, with fairly high *t*-statistics for some industries.

DISTANCE. In all cases except furniture, distance has a strong negative significant coefficient, indicating a drop-off in the probability of a *kabupaten* attracting plants in the industry as the location moves away from major metro areas, controlling for all other *kabupaten* characteristics. This is an unusual result. For example, work on Brazil (Henderson 1988), where much longer distances are involved, as well as on the United States (Henderson, Kuncoro, and Turner 1995), finds little or no effect of access to major national metro areas or regional capitals, *once the analysis controls for* other effects (such as population and diversity). That is, for unincorporated plants whose markets are fairly local, we would expect, after controlling for *kabupaten* characteristics, that access to a major metro area is not very important. The proportion of plants locating in a *kabupaten* would be driven by demand characteristics in that area relative to other areas. But for Indonesia, access to major metro areas is a major determinant of where even unincorporated firms locate. This suggests that to function—get parts, materials, permits, financing—unincorporated firms are drawn out of local markets toward major metro areas. To overcome that draw would require some combination of transport and communication infrastructure development and perhaps institutional reform.

V. DECENTRALIZATION ISSUES: THE HISTORICAL-INDUSTRIAL ENVIRONMENT

The unincorporated sector is influenced in its current location choices by historical location patterns. Getting plants to go to new locations is inherently

difficult, since those locations are poor information environments. To induce plants to go to decentralized new locations would require a program to make those locations sufficiently attractive to overcome historical patterns (see Rauch 1993 for a theoretical treatment of this problem). Moreover, we argue that historical centralization of the corporate sector in Indonesia contributes to enhanced centralization of the unincorporated sector.

To assess the effects of history on current locational choices, we reevaluate the coefficients in table 4. Given the normalization in estimation, another way to interpret the coefficients is to look at percentage changes in probabilities evaluated at the probability for a representative location. The representative location is defined for each industry as a hypothetical location having mean values across geographic areas for all right-hand-side variables. To give a better sense of magnitudes of changing the values of right-hand-side variables, we report the effect of changing each variable's value by one standard deviation on the relative probability of the hypothetical representative location attracting the industry. That is, first we calculate $\bar{P}$, where

$$(5) \qquad \bar{P} = \frac{\exp(\beta \bar{X})}{\sum_{k=1}^{M} \exp(\beta X_k)} \qquad \bar{x} = \sum_{k=1}^{m} x_k / M$$

and then we calculate

$$(6) \qquad \frac{\Delta P}{\bar{P}} = (1 - \bar{P})\beta \Delta x$$

where Δx equals the standard deviation for x about its mean. These results are given in table 5. Given 106 locations $1 - \bar{P} \to 1$, so generally $\Delta P / \bar{P} \approx \beta \Delta x$.

We know that unincorporated firms are strongly influenced in their choices of location by the existing industrial environment. Table 5 tells us that a one-standard-deviation increase in past own-industry employment increases a location's probability of attracting a plant by 14 to 35 percent (except for publishing and paper). In other words, the proportion of new plants in Java that the location attracts rises by these percentages. Similarly, a one-standard-deviation *decrease* in HHI for manufacturing would increase the probability by 2 to 24 percent, and in HHI for all industries by 18 to 51 percent (except for nonmetallic minerals). For the maturity index, the probability increases by 12 to 26 percent.

These numbers suggest that a location's industrial environment, which has been built up over time, has a strong impact on its ability to attract plants today. Consider a simple experiment where we give a representative interior location an industrial environment shock, improving the environment by one standard deviation each for past employment, the two HHIs, and the maturity index. Taken together, that raises the proportion of new plants the location will attract by

Table 5. *Impact on Location Probabilities of a One-Standard-Deviation Increase in the Variables, Java, 1980–85*
(percent)

Variable	*Textiles*	*Furniture and wood products*	*Nonmetallic minerals*	*Machinery*	*Publishing and paper*	*Miscellaneous*
Wages	–0.65	–0.13	(0.03)	(–0.25)	–0.02	–0.38
ln population	0.64	(0.32)	0.45	0.21	1.14	(0.06)
ln 1980 own-industry employment	0.35	0.20	0.23	0.14	0.00	0.17
HHI: manufacturing[a]	–0.24	(–0.06)	–0.11	–0.08	–0.02	–0.15
Maturity index[b]	0.13	0.26	0.22	(0.12)	(0.14)	0.12
HHI: all industries[a]	–0.49	–0.20	(0.09)	(–0.21)	–0.18	(–0.51)
Cumulative for environmental improvement[c]	1.21	0.72	0.47	0.55	0.34	0.95
Percentage existing plants with a generator[d]	–0.19	(–0.06)	–0.09	(0.10)	(0.04)	–0.05
Distance[e]	–0.44	(–0.28)	–0.13	–0.40	–1.17	–0.50

Note: The values in the table are the percentage change in a representative location's probability of attracting a plant, caused by a one-standard-deviation increase in the variable. The representative location is defined for each industry as a hypothetical location having mean values across geographic areas for all right-hand-side variables. See the text for details on the calculations. The numbers in parentheses are based on coefficients with *t*-statistics less than one.

a. The Hirschman-Herfindahl index (HHI) for manufacturing is a measure of diversity of manufacturers. It is the sum of squared shares of employment by two-digit manufacturing industry in all other manufacturing. The HHI for all industries measures local economic diversity. It is the sum of squared shares of one-digit employment in all employment.

b. Maturity of the manufacturing environment is measured by an employment-weighted average of the age of all old manufacturing plants outside the own industry in the *kabupaten*, divided by the national average for each industry.

c. In calculating cumulative effects, effects of 1980 own-industry employment and of the maturity index are added to the negative of the two HHI index effects.

d. Existing plants are those in existence in 1985 that were established before 1980.

e. Distance is measured as the straight-line distance from the center of a *kabupaten* to the center of the nearest of the four metro areas in Java.

Source: Authors' calculations.

121 percent for textiles, 72 percent for wood and furniture, 47 percent for nonmetallic minerals, 55 percent for machinery, 34 percent for publishing and paper, and 95 percent for miscellaneous. The publishing and paper industry, which is dominated by local printing activity, is the least sensitive to the industrial environment shock. The next step is to argue that this environmental shock is a very relevant experiment.

From tables 1 and 2 we saw that the large corporate sector is highly centralized in Indonesia. We have argued that centralization is driven by access to export nodes and by centralization of governmental and financial institutions. Unincorporated firms traditionally did not need to centralize to the same extent because they export little and they were precluded typically from interacting extensively with many central institutions. They were relatively freer to locate in decentralized places (even though we argued that access to major metro areas remains unusually important for them). However, the centralization of the corporate sector itself acts as a magnet drawing the unincorporated plants to the center, so they can enjoy the external benefits of greater existing own-industry employment, greater diversity of the industrial environment, and greater maturity of the established corporate firms. In short, centralization of the corporate sector increases the degree of centralization of the unincorporated sector, and further disadvantages decentralized locations. Moreover, this pattern cannot be changed overnight. To attract more unincorporated plants, decentralized locations would need to attract and *retain* a disproportionate share of new corporate plants to build up their industrial base.

It is hard to know what Indonesia would look like in the absence of centralization of the corporate sector, but here we describe a suggestive experiment. Suppose, for example, that the proportion of *all* manufacturing outside the 50-kilometer radius of the four major metro areas in Java is increased to that of the unincorporated sector. Such a shift in manufacturing employment would double all manufacturing outside the four metro area regions. The resulting effect on the flows of new unincorporated plants would be similar to our one-standard-deviation improvement in industrial environment for the representative city. For example, a doubling of past own-industry employment in the representative interior city represents just under a one-standard-deviation increase in its employment. Such a difference in starting point would strongly increase the proportion of new unincorporated plants going to decentralized locations.

VI. Regime Switches: Institutional Centralization

In our data there are effectively two regime switches concerning centralization. The first is the difference in locational patterns in the incorporated and unincorporated sectors. It is obvious that the corporate sector is highly centralized. The estimation results discussed in the appendix show that traditional market

forces and externalities are less important for the corporate sector. Population effects and access to major metro areas drive location decisions almost entirely.

Here we focus on the second regime switch, the change in locational determinants of the unincorporated sector after the 1983 announcement of liberalization. This comparison will show that liberalization actually may work to increase centralization. To assess the effect of liberalization on centralization, we compared coefficients for unincorporated plants established in 1980–82 with those established in 1983–85. In table 6 we report a general comparison where all coefficients are allowed to vary between 1980–82 and 1983–85; then in table 7 we report a comparison where only the distance coefficient is allowed to vary. Our focus is on the distance variable, but we first comment on issues concerning some general comparisons.

The general comparison has some underlying conceptual difficulties that reflect the problem of our data not being panel data. We study location decisions, based on 1980 conditions, for plants that were established between 1980 and 1985. Plants established in 1980 may react differently to 1980 conditions than plants established in 1985. In particular, there may be a lag structure to prior conditions; the difference in coefficients before and after 1983 may pick up the lag structure in addition to the impact of liberalization. For example, in table 6 for most of the industries, the post-1983 coefficients are more negative for wages and for HHI for all industries. For all industries, the post-1983 coefficients are less positive for past employment. These may simply reflect lag structure effects. Additionally, infrastructure coefficients post-1983 tend to be less negative, another possible result of the lag structure.

In terms of decentralization and liberalization, the two variables of direct interest are population and distance. In table 6, except for textiles, the population coefficient post-1983 is more positive; and the distance coefficient is more negative in all industries except nonmetallic minerals. However, in attempting to pare down the coefficient list to the key post-liberalization variables (distance, wages, population, past employment), only distance survived as a consistently critical variable in any set of combinations. For example, if we start with distance as the only post-1983 coefficient to differ and add in population, it only adds significantly to explanatory power (by a χ^2 test) in one industry. The same comment applies to wages, past employment, and infrastructure.

In table 7 we focus on distance variables. The first row in table 7 lists the distance coefficient from table 4. Note that while table 7 reports coefficients, the proportional difference in probability elasticities is almost identical in magnitude (see equation 5). The second and third rows in table 7 give the values for the basic distance coefficient and the post-1983 slope premium estimated from a reduced-form model. In the reduced-form model, all direct and indirect (for example, population) post-1983 distance effects are captured in the premium coefficient. The fourth and fifth rows in table 7 give the corresponding basic and post-1983 distance effects when all other coefficients are also allowed to vary after 1983 (see table 6).

Table 6. *Logit Results with Slope Dummies for All Variables for the Unincorporated Sector, Java, 1980–85*

Variable	*Textiles*	*Furniture and wood products*	*Nonmetallic minerals*	*Machinery*	*Publishing and paper*	*Miscellaneous*
ln wages	−1.56*	−0.018	0.426*	−1.14*	0.140	−0.499
Post-1983 premium	−0.497*	−0.647*	−0.621*	0.775*	−0.309	−0.894*
ln population	1.02*	0.043	0.605*	0.237*	−0.039	−0.837*
Post-1983 premium	−0.069	0.790*	0.208	0.119	0.175	1.48*
ln own-industry employment	0.414*	0.478*	0.357*	0.338*	0.209	0.879*
Post-1983 premium	−0.057	−0.410*	−0.136	−0.424*	−0.345*	−1.08*
HHI manufacturing[a]	−1.35	−1.25*	−1.85*	−0.046	0.416	0.123
Post-1983 premium	−2.83*	1.04	0.791	−1.91	−1.34	−3.78*
Maturity index[b]	1.01*	0.880*	0.847*	0.267	0.371	0.283
Post-1983 premium	−0.988*	0.111	0.256*	0.352	0.127	0.312
HHI all industries[a]	−11.85*	−1.29	1.91*	−4.12*	0.950	−0.402
Post-1983 premium	−0.635	−1.85	−1.47	2.69	−5.44	−9.45*
Percentage of existing plants with a generator[c]	−0.035*	−0.017*	−0.028*	0.0063	0.047	−0.039*
Post-1983 premium	0.010	0.014	0.026*	0.017	−0.00027	0.047*
Distance[d]	−0.402*	−0.263*	−0.158*	−0.109	−0.933*	−0.553*
Post-1983 premium	−0.260*	−0.131*	0.013	−0.761*	−0.661*	−0.066

Note: To calculate coefficients for overall post-1983 effects, add the post-1983 premium to the base effect.

* Indicates that the variable is significant at the 10 percent level on the basis of uncorrected standard errors.

a. The Hirschman-Herfindahl index (HHI) for manufacturing is a measure of diversity of manufacturers. It is the sum of squared shares of employment by two-digit manufacturing industry in all other manufacturing. The HHI for all industries measures local economic diversity. It is the sum of squared shares of one-digit employment in all employment.

b. Maturity of the manufacturing environment is measured by an employment-weighted average of the age of all old manufacturing plants outside the own industry in the ***kabupaten***, divided by the national average for each industry.

c. Existing plants are those in existence in 1985 that were established before 1980.

d. Distance is measured as the straight-line distance from the center of a ***kabupaten*** to the center of the nearest of the four metro areas in Java.

Source: Authors' calculations.

Table 7. *Impact of Liberalization on the Importance of Access for the Unincorporated Sector, Java, 1980–85*

Model and variable	*Textiles*	*Furniture and wood products*	*Nonmetallic minerals*	*Machinery*	*Publishing and paper*	*Miscellaneous*
Full model[a]						
Distance	–0.53	–0.33	–0.15	–0.48	–1.31	–0.58
Model with distance dummy alone						
Distance	–0.28	–0.20	–0.12	–0.20	–1.0	–0.37
Post-1983 premium	–0.48	–0.22	–0.05	–0.56	–0.52	–0.39
Model with distance dummy and all other dummies[b]						
Distance	–0.40	–0.26	–0.16	–0.11	–0.93	–0.55
Post-1983 premium	–0.25	–0.13	0.01	–0.76	–0.66	–0.06

Note: Distance is measured as the straight-line distance from the center of a *kabupaten* to the center of the nearest of the four metro areas in Java. To calculate coefficients for overall post-1983 effects, add the post-1983 premium to the base effect.

a. See table 4.

b. See table 6.

Source: Authors' calculations.

The pattern is clear in table 7: with the addition of the post-1983 effects, post-1983 distance effects are much stronger than pre-1983 effects. The only exception is nonmetallic minerals, where the distance effect is weakest, and perhaps miscellaneous manufacturing, where indirect distance effects dominate. Particularly for machinery and publishing and paper, direct post-liberalization effects are very strong. They are also strong for textiles and wood and furniture products. Liberalization simply accentuated centralization tendencies for these industries.

As suggested earlier, centralization may have increased because unincorporated firms needed to centralize to take direct advantage of liberalization measures. Alternative explanations exist. For example, as noted earlier, the highly centralized corporate sector grew faster in this time period. Over time, this would help draw unincorporated firms into centralized locations to enjoy informational and other spillover benefits from the corporate sector. Of course, to the extent that liberalization spurred the enhanced growth of the corporate sector, that is still an indirect effect of liberalization on the location patterns of plants in the unincorporated sector. However, we believe that much of the initial increased centralization of the unincorporated sector should be ascribed to direct liberalization effects (for example, centralizing to effectively benefit from liberalization measures). The sharp switch in location patterns in table 2 at the 1983 liberalization argues for direct effects of the regime switch to liberalization. We would expect the indirect location response of the unincorporated sector to growth of the centralized corporate sector to be slow because it took time for that increased growth of the corporate sector to actually accumulate and generate externalities to attract unincorporated plants.

VII. Conclusions

In this article we estimate a model of location decisions for new manufacturing plants in Java, focusing on the unincorporated sector. We find that firm location decisions respond to typical market variables as expected, being adversely affected by higher wages, smaller local markets, and poorer infrastructure. We also find that the local historical industrial environment itself affects location decisions, an association we attribute to dynamic externalities. We interpret this finding as explaining why hinterland locations that lack a particular industry have trouble attracting that industry, even when government policies encourage decentralization. Plants strongly prefer locations with mature plants in related industries that offer a built-up stock of local trade secrets concerning local market conditions, local institutions and politics, and technology. Moreover, in Indonesia the extreme centralization of the corporate sector draws unincorporated plants to central locations so that they can take advantage of positive externalities from the corporate sector.

In this article we also find that, in contrast to other countries, access to centralized locations strongly influences location decisions in Indonesia, even after

controlling for other features of the hinterland. This influence is strongest for incorporated firms, which are most reliant on the centralized bureaucracy for financing, export-import licenses, and other aspects of business. For unincorporated firms, although access is relatively less important, it is still critical.

With this comment on access to central locations in mind, we associate the 1983 regime switch in Indonesia with increased centralization of the unincorporated sector. We believe that the increased centralization occurred because, although liberalization gave unincorporated firms better access to government and other centralized services, firms needed to centralize to take advantage of these opportunities because the bureaucratic process is centralized and communications are poor. The relative increased growth of the corporate sector following liberalization may have also helped to further draw unincorporated plants into centralized locations.

Appendix. Results for the Corporate Sector

In this appendix we present results for the logit model estimated just for new plants for 1980–85 in the corporate sector. Compared to the unincorporated sector, the number of new plants in the corporate sample is small. In the unincorporated sector, new plants span virtually all 106 *kabupatens*. In the corporate sector, for textiles, machinery, and publishing, new plants occur in only about 40 *kabupatens,* with a maximum of 55 in nonmetallic minerals. Given the limited number of locations covered, our results are noisy, but there are some startling patterns.

In table A-1, results are presented for five industries—the sample size for miscellaneous manufacturing was too small to utilize. The infrastructure variable either does not matter or is of perverse sign for all industries. For the corporate sector, access to reliable electricity is not an issue, presumably because the sector either has good access or can readily compensate. Therefore, we dropped it as an explanatory variable.

More generally, the corporate sector does not seem to be so driven by economic factors in choosing locations. Wages, the HHI for all industries, and past own-industry employment routinely all have perverse signs. The last suggests that the corporate sector is trying to spread out (for competitive reasons) and that good intraindustry information for its centralized plants is not so important. Population, the HHI for manufacturing, maturity, and distance have expected signs. Of these, distance is very strong.

Overall, the corporate sector results suggest that these firms are motivated less by conventional economic factors and more by the need to operate in traditional, populous, and centralized locations. To further show this, we constructed two sets of results. First, table A-2 presents the predicted probabilities that plants in the corporate and unincorporated sectors will locate in centralized locations—the *kabupaten* (*kotamadya*) of one of the four major metro areas. These marginal probabilities (that is, predicted for new plants) are compared with the

Table A-1. *Industrial Location for the Corporate Sector, Java, 1980–85*

Variable	*Textiles*	*Furniture and wood products*	*Nonmetallic minerals*	*Machinery*	*Publishing and paper*
ln wages	−1.53*	0.262	−0.273	1.48*	0.547
ln population	0.977*	0.616	1.45*	0.747*	−0.0019
ln 1980 own-industry employment	−0.278*	−0.460	−0.746*	−0.778*	0.098
HHI: manufacturing[a]	−10.6*	−2.19*	−1.66	−7.85*	−1.61
Maturity index[b]	0.328	0.057	1.30*	0.721*	0.279
HHI: all industries[a]	−5.38*	2.01	2.40*	2.17	1.60
Distance[c]	−0.676*	−0.472*	−0.682*	−1.73*	−1.37*
Number of observations	353	177	172	341	316
Number of locations covered	39	51	55	41	38

Note: Coefficients are from logit estimation in which the dependent variable is the discrete choice of *kabupaten* in which to locate.

* Indicates that the variable is significant at the 10 percent level on the basis of uncorrected standard errors.

a. The Hirschman-Herfindahl index (HHI) for manufacturing is a measure of diversity of manufacturers. It is the sum of squared shares of employment by two-digit manufacturing industry in all other manufacturing. The HHI for all industries measures local economic diversity. It is the sum of squared shares of one-digit employment in all employment.

b. Maturity of the manufacturing environment is measured by an employment-weighted average of the age of all old manufacturing plants outside the own industry in the *kabupaten*, divided by the national average for each industry.

c. Distance is measured as the straight-line distance from the center of a *kabupaten* to the center of the nearest of the four metro areas in Java.

Source: Authors' calculations.

average probabilities for these sectors—the proportion of the stock of firms in different industries in one of the four major metro areas. The marginal and average probabilities within each sector are similar.

The comparison of probabilities for the incorporated sector compared with those of the unincorporated sector confirms the raw employment data patterns in tables 1 and 2. Both in terms of marginal and average probabilities, the corporate sector is much more centralized than the unincorporated sector. This is due not just to a distance effect, but to the much stronger population effects in the corporate sector (for furniture and wood products, nonmetallic minerals, and machinery), and the much stronger diversity effects for manufacturing for all industries.

Second, in table A-2 we look at the impact of the distance variable itself, in the corporate sector compared with the unincorporated sector. This compari-

Table A-2. *The Importance of Distance in the Corporate and Unincorporated Sectors, Java, 1980–85*

Measure and sector	*Textiles*	*Furniture and wood products*	*Nonmetallic minerals*	*Machinery*	*Publishing and paper*
Predicted probability of a plant being in one of eleven central kabupatens					
Unincorporated sector	0.46	0.19	0.14	0.30	0.54
Corporate sector	0.64	0.42	0.29	0.58	0.70
Proportion of stock of plants in central kabupaten					
Unincorporated sector	0.48	0.19	0.11	0.35	0.56
Corporate sector	0.62	0.62	0.35	0.62	0.77
Percent change in locational probability with a one-standard-deviation increase in distance					
Unincorporated sector	−0.44	−0.28	−0.13	−0.40	−1.17
Corporate sector	−0.56	−0.40	−0.59	−1.44	−1.22

Source: Authors' calculations.

son tells us the effect of access itself, once we have controlled for other aspects of hinterland locations. In table A-2 we report distance elasticities for the representative (hinterland) location given in table 5. We analyze the impact on the probability of the representative *kabupaten* attracting plants, if the distance variable is increased by one standard deviation. In all cases, the negative effect is larger in the corporate sector—enormously so for nonmetallic minerals and machinery.

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