



Multi-plant operation and headquarters separation: Evidence from Japanese plant-level panel data



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ABSTRACT

This paper shows (i) under what circumstances corporate headquarters (HQs) are separated from production plants and (ii) what type of plants are operated by multi-plant firms. By analyzing Japanese plant-level panel data from manufacturing census, we find that large-sized plants or plants intensively purchasing materials significantly tend to be separated from HQs and become a part of multi-plant operations. This pattern suggests an impact of managerial burden. We confirm the robustness of our main findings by dynamic switching patterns of plant status. Factors of economic geography, such as distance from core, also have noticeable impacts.

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1. Introduction

The corporate headquarters (HQs) of firms manage production plants of different sizes. However, large production plants are likely to require separate HQs, as they need a wide variety of corporate services. A plant with a large number of workers might also necessitate that the HQ be collocated with the plant to ensure direct management by plant managers. Decreasing returns to scale in production or in management would warrant either an independent HQ or the splitting of production across multiple plants. While HQ tends to be concentrated in agglomerated core regions, production should be divided across plants in different locations to save costs of production and/or transport. Separating the HQ or splitting production across multiple plants are corporate decisions that involve serious trade-offs.

These issues are important also for understanding real-world problems. As examined by Duranton and Puga (2005), firms recently fragment production processes and locate various activities in different regions, and HQ functions are increasingly concentrated in core regions such as Tokyo in Japan. Consequently,

it will be informative if we characterize how plants operated by firms with HQs in different locations (possibly in urban core) and plants operated as a part of multi-plant operation differ from plants collocated with HQs in terms of employment, wage and productivity.

This paper investigates how these *corporate* organizational decisions of production interact with the *spatial* organization of production (plant locations) as well as *industrial* organization factors (e.g., plant size). On the one hand, because of rich opportunities for outsourcing corporate services available in regions near agglomerated cores, the HQ is located away from the production plants. On the other hand, firms geographically distribute their production plants over peripheral regions in order to save transport costs for serving the respective local markets. However, the constraint on internal resources, such as management capability, is likely to make the smaller plants more vulnerable to the remoteness from agglomeration.

While previous research (reviewed in the next section) is largely based on firm-level or aggregate data, this paper derives plant-level panel data from Japan's *Annual Survey of Manufacturers*. This paper finds that large-sized plants tend to be separated from their HQs and operated by multi-plant firms. Plants located far from the core regions are likely to have separated HQs and to be a part of multi-plant operations. Our principal findings are robust in panel data format even after controlling for firm-specific effects or

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checking the consistency with dynamic patterns such as entry and plant-type switches.

The rest of this paper is organized as follows. Section 2 reviews related literature. Section 3 describes the plant-level panel data used in the study. Section 4 explains the empirical specifications and reports the estimation results on HQ separation. Similarly, Section 5 presents the results on multi-plant operation. Section 6 checks the robustness of our results by examining dynamic aspects: entry of new plants, and switches of plant status. Finally, Section 7 presents the concluding remarks.

2. Literature review

This section briefly reviews related theoretical as well as empirical research. We should note that direct investigations into HQ separation and multi-plant operation have been limited in industrial organization, international trade, urban economics, and other related fields.

The theory of international fragmentation by Jones and Kierzkowski (2001) serves as a useful starting point. In their paper, they combine constant marginal costs of production with fixed costs for coordinating multiple production processes. These assumptions are motivated by the fact that increasing returns tend to be stronger for service activities than for production activities. If applied to our context, their model predicts that when a firm grows above the threshold size, it chooses multi-plant operations or separated HQs because it becomes profitable even after incurring fixed costs (service link costs) for linking multiple plants and operating separated HQs. According to Baldwin (2008), larger-sized firms are more likely to “unbundle” production processes and corporate functions.

Another theoretical framework relevant to our paper can be found in new economic geography (NEG) literature. The standard models in NEG primarily consider the location of single-plant firms. However, in a rare study in a two-region setting, Ekholm and Forslid (2001) analyze firms producing in both regions (“horizontal multi-region firms”), which should have multiple plants in different locations, and firms producing in low-wage regions and located away from the HQ (“vertical multi-region firms”), which should have HQs separated from the plants. The NEG model by Fujita and Thisse (2006) also examines how the decision to separate the HQ is influenced by the cost of communication between the HQ and plants, while Saito (2015) analyzes how multi-plant operations differ between high-productivity firms and low-productivity firms. While these theoretical models have focused on the impacts of trade/communication costs, this paper empirically studies not only the distance from core but also heterogeneous plant characteristics, such as plant size.¹

Our plant-level estimation complements previous empirical research at the firm level, such as Davis and Henderson (2008) and Strauss-Kahn and Vives (2009). From U.S. firm-level data, Atalay et al. (2014) find that transactions of goods between upstream and downstream plants within the firm boundary are extremely rare and plant/firm size is the strongest determinant for vertical ownership. They propose that the provision of corporate intangible inputs from the HQ, rather than intra-firm trade in goods, determines which plants are owned by vertically linked firms.

On the other hand, Aarland et al. (2007) investigate the decision to separate the HQs in U.S. firms and find that firms with separated HQs tend to be larger. By relating the HQ location with such a decision, Ono (2003) argues that U.S. plants tend to rely more on

HQs in outsourcing (i.e., outsourcing directly through plants less actively) when HQs are located in larger markets, where outsourcing opportunities are abundant.

Recent studies based on U.S. plant-level data analyze the impact of HQ-plant communications on the plant's performance, though they do not examine the HQ separation decision itself. Giroud (2013) finds that new airline routes that reduce HQ-plant travel time raise investment and productivity of the plants. Kalnins and Lafontaine (2013) report that plants with shorter distance to HQ tend to survive longer among business establishments in Texas.

Compared to studies on HQ separation, empirical studies on multi-plant operation have been fewer in number.² As far as we know, the book *The Economics of Multi-Plant Operations* by Scherer et al. (1975) is the most prominent work dedicated to the analysis of this issue. However, their study, based on the structure-conduct-performance paradigm in traditional industrial organization, focuses not on the decision of multi-plant operation per se, but on aggregate data on the number of plants or the average plant size operated only by leading firms; thus, it neglects plants/firms without a dominant market share or the effect of plant size.

Although the choice of multi-plant operation itself is *not* the focus of their analyses, several studies recently investigate how multi-plant firms differ from single-plant firms. For example, Bernard and Jensen (2007) find that multi-plant firms and U.S. multinationals are more likely to close plants in the U.S. In analyzing characteristics of closed plants, Kneller et al. (2012) confirm that domestic multi-plant firms and multinational multi-plant firms in Japan are similar.³ Both studies suggest that multi-plant operation, not multi-nationality, is the key factor, but mainly examine whether multinationals are different from domestic firms in the particular decision: plant closure. This paper characterizes plants operated by multi-plant firms in comparison with those operated by single-plant firms, irrespective of the nationality. While foreign ownership plays an important role in our current society, the investigation of multinationals is beyond the scope of this paper due to the data limitation as explained below.⁴

Though HQ separation and multi-plant operation have been examined individually in previous literature, the same set of economic factors, such as plant size and economic geography, are quite likely to affect both decisions. Consequently, this paper investigates these two issues using the same plant-level data.

3. Plant-level data

This section describes the data used in our study. We derive plant-level panel data from Japan's *Annual Survey of Manufacturers* (*Kogyo Tokei* in Japanese). Our sample consists of all plants with four or more employees, as original plant-level micro-data files of the central government are maintained only for plants above this threshold size (even for the most recent census).

Data on basic plant characteristics, such as output (sales), employment (number of regular workers), and expenditure on materials, are available for all plants in the census. The census also captures valuable information regarding whether each plant is a

¹ Our analysis also differs from recent international trade models for offshoring, as they focus on the boundary of the firm under incomplete contract (e.g., Antràs and Helpman, 2004).

² Fujita and Gokan (2005) theoretically analyze whether the HQ manages one or two plants in a two-region NEG setting as in Fujita and Thisse (2006), and show that the option of multi-plant operations is chosen when trade costs are high.

³ Although they use detailed firm-level data, Kneller et al. (2012) concentrate on large- or medium sized firms (basically with 50 or more employees) in Japan.

⁴ By focusing on an early sample (1978–1990), Okubo and Tomiura (2011) avoids problems associated with relocations across national borders, as manufacturing census does not cover plants domiciled overseas. However, plant identifier to construct panel data are unavailable for these earlier years.

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