Identifying Neighborhood Effects among Firms: Evidence from Location Lotteries of the Tokyo Fish Market*

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Abstract: The idea that firms benefit from the characteristics of neighboring firms is central to the economics of agglomeration. A fundamental challenge in investigating such mechanisms arises from economic agents' self-selection into locations. This makes it difficult to distinguish whether certain neighboring firms allow firms to perform better or whether such firms just cluster together. We overcome this challenge by analyzing neighborhood effects among intermediate wholesalers located in the Tokyo Tsukiji Fish Market and by exploiting a unique feature of their shop locations within the market: their locations are determined every 4-10 years by relocation lotteries. First, we confirm that their shop locations are indeed randomly distributed. Then, we find that the characteristics of the neighboring firms significantly affect firm performance. Specifically, the diversity of the types of neighboring firms as well as the fraction of neighboring firms selling similar products positively affect the performance of small-size and specialized firms. We find no effect of characteristics of close neighbors not facing the same corridor, and thus not sharing buyers, which provides evidence that our results are not due to factors other than customers, such as technology spillovers. Our results provide the first randomization-based evidence of the key theoretical mechanism of the formation of market places: agglomeration saves the search cost of the buyers.

Keywords: Neighborhood effects, Lottery.

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1 Introduction

The idea that firms benefit from the characteristics of neighboring firms is central to the economics of agglomeration. Traditionally, economists have focused on firm interactions through learning spillover or input-output linkages. On the other hand, certain types of agglomeration may not perfectly fit such firm interactions, particularly for firms in service sectors. For example, retail firms often form clusters within a city and provide a wide variety of products in the clusters. Diamond Jewelry Way (on 47th Street) in Manhattan and Akihabara in Tokyo are typical cases of such retail clusters. Shopping malls and centers are also typical cases.

To explain retail clusters, economists have provided theories based on ideal variety (Wolinsky, 1983; Konishi, 2005) or love of variety (Henkel, Stahl and Walz, 2000, Arakawa 2006 and Tabuchi 2009). In both constructs, clusters of retailers allow consumers to save the search cost to either find the ideal variety or find a set of complementary varieties. These ideas suggest that firms would perform better if they were surrounded by firms selling similar types of products or by firms selling other diverse complementary products, respectively.

Identifying these types of neighborhood effects has been difficult for two reasons. First, a fundamental challenge in identifying these effects, or neighborhood effects of any type, is the endogeneity problem that results from the self-selection of firm locations. The self-selection of firm location makes it difficult to distinguish whether certain neighboring firms allow firms to perform better or whether such firms just cluster together. Second, the detailed information of the location within market places or clusters has not been easily available.

We overcome this challenge by analyzing the spillover effect among fish intermediate wholesalers located in the Tokyo Tsukiji Fish Market and by exploiting a unique feature of their locations within the market: their locations are determined every 4-10 years by relocation lotteries. In our sample period, the Tokyo Tsukiji Fish Market hosts approximately one thousand intermediate fish wholesalers, specializing in different types of fish.[1] The feature that the location of firms is randomly determined by the lotteries implies that the characteristics of the neighborhood are generated by chance, meaning that within a market, there are areas

[1]Intermediate wholesalers are intermediary firms who purchase fish from wholesale traders, who receive fish from outside the market, and sell to restaurants and supermarkets. See Section 2 for more detail. We use the term "intermediate wholesalers" according to Bester (2004), a comprehensive anthropological study of the Tsukiji market. Throughout the paper, we also use "firms" to indicate the intermediate wholesalers.

with more exogenously generated diversity and areas with less of it, for example. Furthermore, the lottery eliminates self-selection into locations and neighborhoods, allowing us to estimate the causal effect of the various characteristics of neighboring firms, including the fraction of the same type of firms and the diversity of other firms, on firm performance. We also collect the exact location of every intermediate wholesaler within the market and thus those of their neighbors.[2]

The Tokyo Tsukiji Fish Market is particularly suitable for our purpose. In addition to the very rare opportunity to exploit a random source of variation in firm locations, there are two noteworthy features. First, the intermediate fish wholesalers are all firms in a very narrowly defined industry, but they still exhibit heterogeneity along the dimensions of theoretical interest. For example, the fish they sell can be divided into ones with highly differentiable characteristics and quality. Second, the fact that they are all located in the same market place means that there is no role for the consumer-side factors, such as amenities, and that there is no permanent vertical buyer-supplier relationship among them.[3] In short, the Tsukiji market provides an ideal setting for testing hypotheses that firms benefit from certain characteristics of neighboring firms of similar types.

We proceed with our analysis according to the following steps. First, we perform various types of analysis to show that the locations of the intermediate wholesalers are indeed randomly distributed by the location lotteries. Then, we find that the characteristics of neighboring firms significantly affect firm performance. Specifically, both the diversity of the neighboring firms and the fraction of neighboring firms selling similar products positively affect the performance of specialized firms. Additionally, we find some evidence that the share of large firms in the neighborhoods decreases the performance of similarly large firms. Then, we demonstrate that our results are robust when we use alternative measures of diversity and specialized firms. Finally, we present the analysis by changing the definition of the neighborhood. We show that firm performance is influenced by the characteristics of other firms facing it across a corridor (i.e., sharing buyers), but not by the characteristics of other firms equally close yet on a different corridor from the firm (i.e., not sharing buyers). This confirms that the

[2] In this paper, we focus on one lottery cycle in 1990 and analyze the firm performance until 1995, which is the year that the next lottery took place. We plan to extend our analysis to more lottery cycles.

[3] A firm can buy fish from other firms if it encounters a shortage of fish on a particular day, or it can sell fish to other firms that run short of their fish, but these should cancel out over time.

neighborhood effects we find arise from the interaction of firms through their buyers.

The mechanism we empirically identify has been a central theoretical mechanism to explain market places or within-city agglomeration in extended versions of New Economic Geography (NEG) models. A canonical NEG model, which features one industry with horizontally differentiated varieties, has provided a powerful set of tools to analyze why some cities are more agglomerated than others, but cannot explain within-city agglomeration of some industries or market places. Wolinsky (1983), Konishi (2005), Henkel, Stahl and Walz (2000), Arakawa (2006), and Tabuchi (2009) describe the mechanism of organizing marketplaces within a city. Wolinsky (1983) explains the formation of retail clusters by the ideal demand approach. Each consumer has an ideal demand for the product characteristics, and each firm sells specialized products, which have specific characteristics. Under these circumstances, market places with a large number of firms emerge to attract consumers through reducing search costs for the product that matches the consumer's preference. Konishi (2005) further introduces price competition across firms and shows that low price expectations as well as reducing search costs make the clusters attractive for consumers. The other approach is based on the consumer's love of variety preference. According to the love of variety preference, the substitutability of heterogeneous products attracts consumers dispersed in space to marketplaces. Henkel, Stahl and Walz (2000), Arakawa (2006), and Tabuchi (2009) describe the mechanism of organizing marketplaces within a city through this mechanism. In both cases, the cluster of retail firms increases their performance through reducing consumers' trip costs. However, due to the identification difficulty and limitation in data availability, few empirical studies exist that shed light on the empirical relevance of the mechanism.[4]

Among the few empirical studies, Benmelech et al (2014) and Shoag and Veuger (2015) are two papers closely related to ours. Both find that retail firms' performance deteriorated when a branch of a national retail chain in their neighborhood disappeared because of the bankruptcy of the whole chain. They interpret their respective findings as evidence of neighborhood spillover effects. Our study is different in several dimensions. First, we have random variations in all firms' locations due to the lotteries. This allows us to also analyze various forms of spillover effects. For example, we can analyze the effect of the diversity of types of neighboring

[4]Recently, Davis, Dingle, Monras, and Cosman (2014), Courture (2015) and Jardim (2015) analyze detailed micro-data to analyze the economic geography within a city.

firms, the effect of the agglomeration of firms of the same type, and the effects of having more high-performing firms in the neighborhood, each of which can shed light on distinct mechanisms behind the neighborhood effects.

Our paper is also related to the natural experiment approach in economic geography. Researchers have exploited as natural experiments various factors, such as disasters,[5] bombings,[6] changes in borders,[7] and the creation and closure of transportation.[8] Within this approach, our paper is most closely related to Greenstone, Hornbeck, and Moretti (2010), Hornbeck and Keniston (2014), and Redding and Sturm (2016). Greenstone, Hornbeck, and Moretti (2010) compared the productivity evolution of firms in US counties that successfully attracted large plants and those in counties that did not. Our study is different in that, due to random variations in all firms' location, we can analyze more flexible forms of spillover effects, which are not limited to the effect of large plants. Hornbeck and Keniston (2014) found, in the context of the Great Boston Fire, long-term positive effects of locations' own and neighbors' destruction on subsequent reconstruction. Redding and Sturm (2016) found, in the context of the London bombing by Germany, long-term negative effects of locations' own and neighbors' wartime destruction on house prices and the social economic status of the residents. Since the destruction, either by fire or bombing, is plausibly exogenous, the effects of neighborhood's destruction provides compelling evidence of spillover. Our study focuses on purely the production side and finds evidence of firm-to-firm spillover effects on firm-level performance, while the mechanism of urban sorting they identified could include both production and consumption externality (i.e., amenity). Thus, our paper is complementary to Hornbeck and Keniston (2014) and Redding and Sturm (2016) in that our paper focuses more on a specific and narrow mechanism of spillover, while their study provides evidence of the implication of spillover (i.e., urban sorting).

Finally, many areas in economics have been increasingly exploiting random variations gen-

[5]See, for example, Hornbeck and Keniston (2014), for the analysis of the Great Boston Fire of 1872.

[6]See, for example, Davis and Weinstein (2002) for the analysis of the allied bombing in Japan, and see Redding and Sturm (2016) for the analysis of the German bombing in London.

[7]See, for example, Redding and Sturm (2008) and Burchardi and Hassan (2012) for the analysis of the German division and reunification, and see Nakajima (2008) for the analysis of the separation of the Korean Peninsula from the Japanese territory.

[8]See, for example, Redding, Sturm, and Wolf (2011) for the analysis of a closure of a major airport in Germany, see Faber (2014) for the analysis of a construction of highways in China, and see Bernard, Moxnes, and Saito (2015) for the analysis of the new construction of a bullet train route in Japan. In the context of international trade and growth, Feyrer (2009) analyzes the closure of the Suez Canal from 1969 to 1975.

erated through lotteries or (i.e., quasi) random assignment to estimate the spillover effects, including the following: peer effect of roommates in dormitories (Sacerdote, 2001); neighborhood effects on employment (Kling, Liebman and Katz, 2007, Kondo and Shoji, 2015, and Chyn, 2016, among others); productivity effects of co-workers in the workplace (Mas and Moretti, 2009, and Bandiera, Baranky and Rasul, 2010); impact of collaborators in scientific outputs (Azoulay, Zivin and Wang, 2010); peer effects of inmates in crime (Bayer, Hjarmarsson and Pozen, 2009); and peer effects in sports (Brown 2011, Yamane and Hayashi, 2014). To the best of our knowledge, we are the first to exploit a random source of variation in firm locations generated by lotteries.

This paper is organized as follows. Section 2 describes the background information of the Tokyo Tsukiji Fish Market and the details of the relocation lottery. Section 3 describes the data and empirical strategy. In Section 4, we provide evidence of the exogeneity of the locations due to the lottery. The estimation results of the neighborhood effects are explained in Section 5. Section 6 concludes.

2 Background

2.1 Tsukiji Fish Market

The Tsukiji market, located in downtown Tokyo, is the biggest wholesale fish and seafood market in the world. The market handles more than 700,000 metric tons per year (e.g., 2,000 tons daily) of more than 400 different types seafood. There are more than 1,000 firms, including wholesalers, intermediate wholesales, related equipment and machinery companies, which together employ more than 60,000 workers. Fish that arrives from all of the ports in Japan and from around world are first handled by seven large wholesale traders (i.e., "O-oroshi" in Japanese). Then, the wholesale traders sell the fish to intermediate wholesalers, either through auctions or through direct negotiations. Next, the intermediate wholesalers, at their shops within the market place, resell the fish to their customers, which include supermarkets, fish stores, or restaurants. The flow of fish from producers to consumers is summarized in Figure 1. This paper focus on the relationship between the intermediate wholesalers and

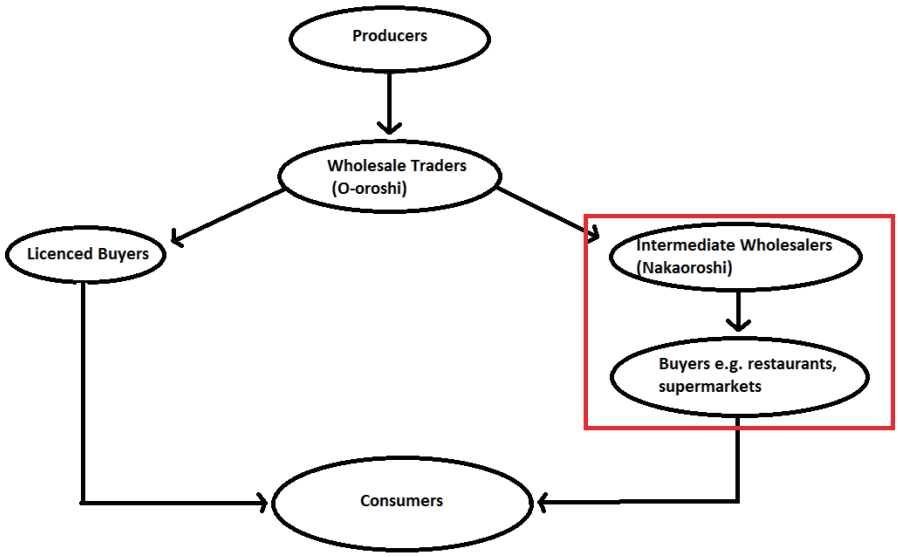


Figure 1: Flow of Fish

Table 1: Overview of trade groups in 1990

Name	Product	Variable name	Number of firms	Number of shops
Omono	Tuna	Tuna	334	545
Tokushumono	Fish for Sushi	Sushi	236	531
Enkai	Popular fish outside Tokyo	Enkai	144	224
Kinkai	Popular fish within Tokyo	Kinkai	109	174
Hokuyo	Salmon	Salmon	75	170
Ebi	Shrimp	Shrimp	68	134
Aimono	Half-processed fish	Aimono	63	108
Renseihin	Fish cake	Renseihin	61	113
Enkanmono	Dried fish	Enkan	55	102
Enyomono	Fish in Far Ocean	Enyo	27	94
Tako	Octopus	Octopus	22	29
Tansuigyo	Freshwater fish	Tansui	16	30
Togei	Whale	Whale	16	74
Tsukudawakai	Tsukudani	Tsukudawa	8	18
Iseebi	Japanese Lobster	Isesbi	8	23
Tookakai	Shirk	Shirk	4	4

buyers, as shown in the rectangular box in Figure 1.[9]

2.2 Types of Intermediate Wholesalers [Nakaoroshi]

Intermediate wholesalers can be classified according to several dimensions. First, they have different fish specialties. In the Tsukiji market, there are sixteen trade groups (i.e., "Gyokai") formed by firms of similar specializations. Intermediate wholesalers form these trade groups to negotiate with other interested parties. Trade groups could be directly associated with specific fish like Tuna, with fish caught from specific locations, or with the way the fish are handled. One trade group that is exceptional is the trade group of intermediate wholesalers who specialize in high-quality fish served at Sushi restaurants and high-end Japanese cuisine restaurants. As we mentioned above, firms in Tsukiji belong to trade groups depending on the type of the fish they handle. Table 1 shows the list of the trade groups, the type of fish each trade group handles, and the numbers of firms and shops in 1990.[10] Tuna has the largest share of firms and shops in Tsukiji. Then, Sushi is the second largest. Third and fourth largest are the Enkai and Kinkai firms, which mainly sell their fish to supermarkets and small and

[9]Some large supermarket chains can buy directly from wholesale traders if they obtain a license. They are shown as "Licensed Buyers" in the figure.

[10]A firm can have multiple shop spaces. The explanation of shop spaces is in the next section.

mid-sized fish shops.[11] These four categories are the main trade groups in the Tsukiji Fish Market. At the same time, we can observe that there are a certain number of firms that only handle extremely specialized seafood such as shrimps, Japanese lobsters, octopus, and sharks.

Second, intermediate wholesalers can either sell to large-scale supermarkets or to smaller restaurants. Third, they can be different in their degree of specialization and diversification of the type of the fish they handle. Fourth, they can be heterogeneous in the number of shops they have in the market place. These factors are correlated to one another. Generally, intermediate wholesalers belonging to trade groups that are characterized by the location of fish are more likely to sell to large-scale customers and to handle many varieties of fish. On the other hand, intermediate wholesalers who belong to either the trade group dealing with fish for Sushi or the trade group of specific fish are more likely to sell to a smaller-scale customer and to specialize in one of a few varieties of fish.

2.3 Building for Intermediate Wholesalers

The building for intermediate wholesalers are a quarter circular shape, as shown in Figure 2.

As Figure 2 shows, the building for intermediate wholesalers consists of 12 rows and 15 column blocks of stalls (i.e., shop spaces),[12] where each column block has eight to twelve stalls. Each small rectangle in the figure is one stall. There are approximately 1,700 stalls overall. Rows and column blocks are divided by vertical streets and horizontal corridors.[13] All of the horizontal corridors between rows have the same width, but the width of the streets between columns is different. As Figure 2 shows, there are seven large vertical streets and eight narrow vertical streets.[14] Characteristics of the stalls differ within the building. As we can see from the figure, stalls in the rectangular area are of the same size, but in the circular area, stalls become larger from the inner to the outer parts (i.e., from the bottom part of the figure to the top part). On the average, the area of one stall is $7.2m^2$. The main entrance of the building for buyers is located in the bottom left of the figure. Buyers walk through the building to shop for fish. Thus, the rectangular area and the stalls in the bottom part of the figure are attractive

[11] Enkai and Kinkai mean "far coast" and "near coast," respectively. The former is outside the greater Tokyo bay area, while the latter is in the greater Tokyo bay area. These two trade groups merged into one group in the 2000s.

[12] We use stalls and shops interchangably.

[13] We use "street" to indicate a vertical street, while we use "corridor" to indicate a horizontal corridor.

[14] They are literally called "large streets" and "small streets" in the market.

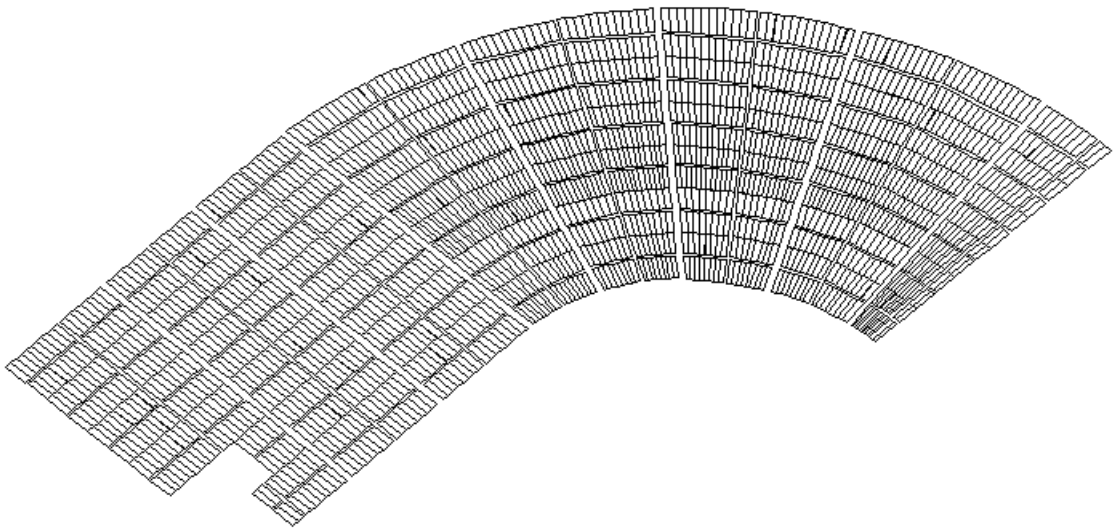


Figure 2: Shape of the Tsukiji Fish Market

because they provide easy access to the customers. As for the customers' accessibility, the stalls located on the corners of one of the large streets are also attractive since the other corridors and streets are quite narrow. As mentioned above, the attractiveness of stalls is different and greatly affects the performance of the firms. The intermediate wholesalers agree that the stalls on the corner are good locations for them. Ensuring fairness for the firms in terms of their locations is one important reason why they continue to use the location lottery system for the long term.

Since there are approximately 1,700 stalls (i.e., shop spaces), which are more than the number of firms, some firms occupy more than one shop space. Firms can extend their shops by buying the right of stall-holding from the other firms. When they occupy more than one shop space, they almost always occupy spaces that are horizontally next to one another because of the convenience for the business[15] [16] and due to the lottery design, which we explain below.

2.4 Relocation Lotteries

The market and the land are owned by the Tokyo Metropolitan government. The relocation lottery was introduced to mitigate inequality and unfairness associated with the locational advantages described in the previous section. These relocations (i.e., Tempo Ido) have been huge events as they involve the whole re-installation of equipment for every shop. The relocations and associated lotteries have been taking place every four years until 1990. After 1990, the timing becomes irregular because of debates on the relocation of the whole market. The lotteries have been performed in 1990, 1995, and 2004.

Each lottery consisted of two parts: the preliminary and main lotteries. In the preliminary lottery, the market is divided into four blocks. Then, firms submit their preference to one another. If there are more firms than locations in these blocks, the lottery is implemented to determine who can enter the block. If a firm does not win a lottery for a block, the firm has to reapply to a different block where there is still a vacancy. Figure 3 shows the blocks for the

[15] Since the average size of a stall is only $7.2m^2$, the benefit of using connecting stalls without a wall is large.

[16] One may be concerned that it is difficult to buy the right of stall-holding from horizontally located firms. However, in the location lottery, a firm with multiple shops applies for one lottery for all of its shops and can thus have their shops next to one another. Therefore, a firm that plans to extend its shops does not need to buy the right of stall-holding from the horizontally located firms if they buy the right of stall-holding just before the lottery. Actually, most of the trading rights for stall-holding takes place just before the location lottery.

preliminary lottery. Then, after which block the firms go to is determined, the main lottery is held for each block, and the exact location within the block is determined.

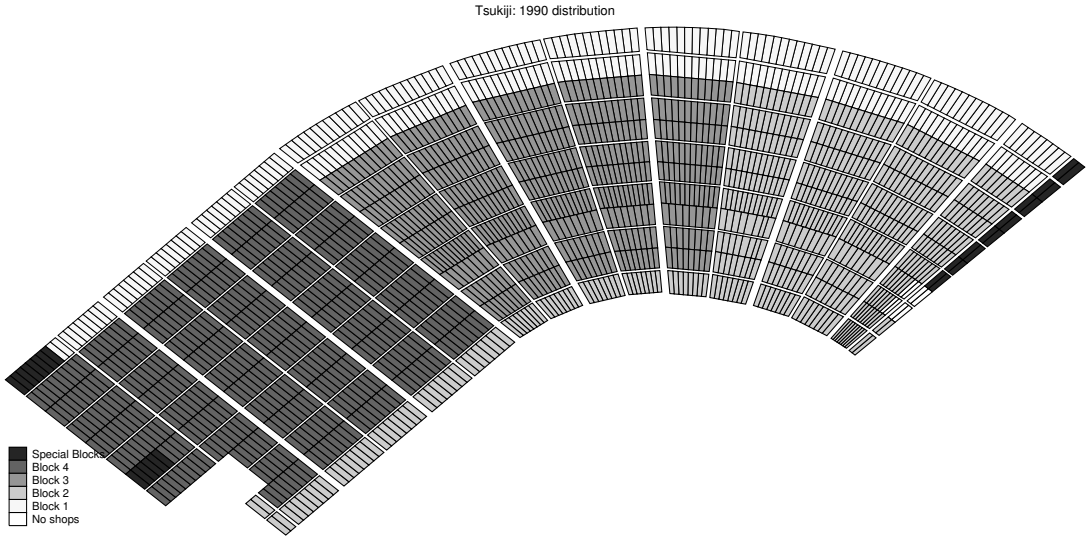


Figure 3: Blocks for the preliminary lottery

The unit of application for the lottery is two shops. Single-shop firms have to form a pair. The group application of more than one unit is allowed, but it is not the majority in practice. Location is determined by the number in the lottery, from the first row from the left to right, and then to the second row, from the right to left, etc., within the block. A firm with multiple shops (i.e., multi-shop firms) applies for one lottery for all of its shops, thus making their shops one next to another. One feature of the lottery worth emphasizing is that the lottery number would not determine the exact location ex ante because of the assignment rule and of the existence of multi-shop firms. The exact location of a firm depends on its lottery number and the number of shops that will have been occupied by the other firms who draw lottery numbers smaller than the one of the firm. This feature is useful in preventing fraud since there is no point in aiming for a particular lottery number.

The system allowing group applications can potentially pose a threat to our identification strategy, as there is a degree in which horizontal neighbors are self-selected. Indeed, Bester (2004) documents anecdotes of group applications. Our analysis for the validity of randomization, presented below, suggests that group applications are not leading to a systematic violation of randomization. A suspicious reader could wonder whether this could be because our data are not capturing all of the relevant characteristics. However, neighbors facing across

horizontal corridors are completely out of the control of the firms because the lottery numbers of the two shops facing each other are typically far apart, which is a point also mentioned by Bester (2004). In the robustness check section, we will explore this feature.

2.5 Anecdotes of Neighborhood Effects

The mechanisms of neighborhood effects, the love of variety effect, and the ideal variety effect that we explore are recognized as realistic channels of spillover effects among intermediate wholesalers.

Anecdotes of the love of variety effect

The term "Tsuidegai" is used in the Tsukiji fish market. This term refers to a mostly unplanned purchase of fish at one shop after a planned purchase of another type of fish nearby.[17] We have ample stories demonstrating "Tsuidegai" from our interviews with managers of intermediate wholesalers. One manager told us that shops selling fish for Sushi can benefit from the presence of a high-performing shop specialized in tuna because a Sushi restaurant chef typically buys tuna first and then looks for other fish. Another manager who specializes in high-quality whitefish for Sushi restaurants told us that his shop would benefit from the presence of other shops that specialize in other types of high quality fish for Sushi. On the other hand, a manager who operates a large-scale shop dealing with popular fish shared that "Tsuidegai" is not important for his business as his customers are large-scale supermarkets. This suggests that a more specialized shop is likely to benefit more from the diversity of other shops.

Anecdotes of the ideal variety effect

In the Tsukiji fish market, the agglomeration of shops selling the same type of fishes may also be beneficial for these shops. Consumers who have their ideal demand can search for seafood that matches their ideal characteristics. In fact, as a result of the 1995 location lottery, a cluster of firms selling salmon has emerged. An industry newspaper (e.g., "Nikkan Shokuryo Shimbun") reports this area as "The Salmon Road" and writes that it would be attractive for consumers as all types of salmon from any part of the world are available there. At the same

[17] "Tsuide" literally means "on the occasion of" or "in addition to" in Japanese, and "gai" means "purchase."

time, the paper also reports the voice of the salmon shop owners who worry about intensive competition among the various salmon shops in the same location.

3 Data and Empirical Strategy

3.1 Data

For our analysis, we need to know the exact location of firms within the market and characteristics of firms. We use industry newspapers ("Nikkan Shokuryo Shimbun") and the directories ("Kumiaiin Meibo") compiled by the union (To-oroshi) and the news paper company ("Nikkan Shokuryo Shimbun") for years of location lotteries, 1990 and 1995. Directories compiled by the union (To-oroshi) and the news paper company ("Nikkan Shokuryo Shimbun") provide information of location and trade group affiliations which allows identify the fish specialties of firms. Furthermore, we obtain the block information on the preliminary lottery from industry newspapers ("Nikkan Shokuryo Shimbun") .

Table 2 shows number of firms, transaction volume, and value in Tsukiji fish market in our data periods. From 1990 to 1995, the number of firms, transaction volume both in tons and

Table 2: Number of firms, transaction volume, and value in Tsukiji fish market

Year	Number of firms	Transaction volume (million ton)	Transaction value (billion yen)
1990	1040	713.5	705.8
1995	985	629.4	579.2

yen are declined.

3.2 Key mechanism of spillover effect

Both theory and anecdotal evidence of the neighborhood effects suggest that certain features of firms comprising a neighborhood reduces the trip and search cost of buyers who have either their ideal demand for a specific characteristics of fish or demand for varieties of fish. Therefore, we investigate the following hypotheses.

Hypothesis 1: Neighborhood diversity positively affects the firm performance

This hypothesis states that the wide variety of specialized neighboring firms makes a neighborhood more attractive through "Tsuidegai" coming from the customers' love of variety preferences, affecting positively firm performance in such a neighborhood. This diversity is likely more beneficial for more specialized firms. More diversified firms may benefit less from such neighborhoods because they themselves are already internally diversified.

Hypothesis 2: Fraction of neighboring firms in same trade group affects the firm performance

This hypothesis states that the presence of other firms belonging to same trade groups makes a neighborhood more attractive because it makes more likely that buyers can find exactly what they are looking for (their ideal variety). Therefore, it positively affects the performance of the firm in such a neighborhood. Again, this benefit is likely to be higher for more specialized firms because it is likely that there is a larger degree of heterogeneity in their products. Again, for more diversified firms, competition effects arising from having many firms of similar type may dominate the benefit.

Hypothesis 3: Neighboring productive firms affect the firm performance

This hypothesis is not necessarily directly linked to the love of variety or the ideal variety stories. However, it is natural to think that the presence of other bigger or productive firms makes areas more attractive (through "Tsuidegai") or more competitive. It is also natural to think that the effect of this presence of other bigger or productive firms would depend on whether firms are specialized or diversified.

3.3 Empirical Strategy

We test the hypotheses by regressing firm i's performance on its neighborhood characteristics. To construct neighborhood characteristics variables, first, we define *neighborhood region* as

the unit of the areas in which neighborhood effects arise. We define a neighborhood region as a set of stalls that is consisted by two rows and column blocks of stalls between vertical large streets and the stalls shareing one horizontal corridor. An example of the neighborhood region is shown in the Figure 4. The black colored area is a neighborhood region. We assume that neighborhood effects on firm i's operate within the neighborhood region in which the firm locates.

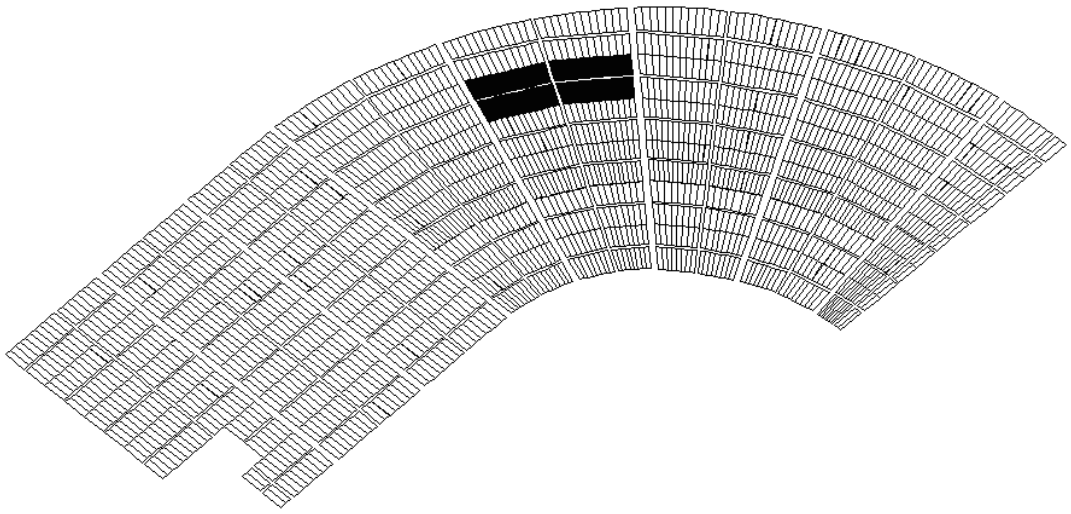


Figure 4: Example of a Region

Based on the neighborhood region, we investigate how the neighborhood characteristics determined by the 1990 lottery affect firm performance from 1990 to 1995, the next lottery year. That is, we regress changes in firm i's performance from 1990 to 1995, by the firm's neighborhood characteristics in 1990. The estimation equation is as follows,

$$\triangle y_{igr} = \beta_0 + \beta_1 Neighbor_{gr} + \beta_2 MultiOwn_i + \beta_3 Neighbor_{gr} * MultiOwn_i + (\gamma X_{igr}) + \lambda_g + \varepsilon_{igr},$$

where $\triangle y_{igr}$ is the measure of the changes in the performance of firm i in trade group g located in neighborhood region r from 1990 to 1995, $Neighbor_{gr}$ is a measure of neighborhood characteristics of trade group g in neighborhood region r in 1990, $MultiOwn_i$ is dummy indicating whether firm i is multi-shop firms, X_{igr} is the set of other characteristics of the firm in 1990, λ_g is trade group fixed effects, and ε_{igr} is stochastic disturbance.

As for firm i's performance, we use the information of number of shops the firm owns. As we mentioned, firms can extend their shops by buying right of stall-holding from other firms. The number of shops can be considered as a measure of firms' performance. Specifically, we construct a dummy variable for exit, $exit_{igr}$, which takes one if firm i exits from the market and zero otherwise. We also construct $\triangle Shops_{igr}$, changes in the number of shops from 1990 to 1995, conditional on survival. As a variable that captures both dimensions of the two variables, we also use $Dincrease_{igr}$, the dummy variable taking one if firm i increases its number of shops from 1990 to 1995, and zero otherwise (including exit).

On the neighborhood variables, based on the above discussed hypotheses, we construct three variables. For Hypothesis 1, we use the total number of unique trade groups to which neighborhood firms belong as the neighborhood diversity variable. Next, for Hypothesis 2, we use the fraction of other shops in region r belonging to the same trade group as firm i to capture the agglomeration effect of the same trade group. Finally for Hypothesis 3, we use the fraction of other shops owned by multi-shop firms to capture the spillover effects from productive firms or firms competing in standardized products. Finally, since we conjecture in all the hypotheses that the neighborhood effects are different by the degree of specialization, we consider the interaction term between the neighborhood variables and a dummy variable indicating whether firm i is a multi-shop firm, $MultiOwn_i$. This is based on our understanding of the market from interviews that multi-shop firms are more likely to be in the non-specialized segment of the market. In the robustness check section, we examine alternative measures of specialization.[18]

As for the initial firm characteristics, to control for the physical location characteristics,

[18]One difficulty of using the multi-shop dummy as an indicator of non-specialized firms is that the multi-shop dummy could be interpreted as a proxy of performance or productivity. This issue is worse in the current version of the paper because we are using the number of shops in the construction of the dependent variables as the performance measure. We hope to solve this issue by using the Census of Commerce, which would allow us to control the sales and employment of firms. We have already data access authorization, but we have not had the dataset yet.

we include the corner dummy indicating whether firm i locates on the corner of a large vertical street and 1990 lottery block fixed effects. To control for the size of firms, we include multiple-shop dummy as above mentioned, and to control for the specialization situation, we control the number of trade groups to which firm i belongs, which we call "own diversity". Table 3 shows the summary statistics of the key variables. We also show the summary statistics of each

Table 3: Summary statistics

	Single Store	Multi Store	Total
Dummy for Exit	0.13***	0.06***	0.11
	[0.01]	[0.01]	[0.01]
Dummy for Increasing the Number of Shops	0.09*	0.13*	0.1
	[0.01]	[0.02]	[0.01]
Changes in the Number Shops Conditional on Survival	0.12***	0.00***	0.08
	[0.02]	[0.05]	[0.02]
Dummy for Owning a Store on the Corner	0.09***	0.28***	0.15
	[0.01]	[0.02]	[0.01]
Number of Trade Group Affiliations (Own diversity)	1.03***	1.32***	1.13
	[0.01]	[0.03]	[0.02]
Number of Trade Groups in the Neighborhood Region	9.24	9.08	9.19
(Neighborhood diversity)	[0.07]	[0.09]	[0.06]
Fraction of the Firms from the Same Trade Groups	0.18***	0.25***	0.2
in the Neighborhood Region	[0.01]	[0.01]	[0.01]
Fraction of Firms Owning Multi-Stores	0.36	0.35	0.36
in the Neighborhood Region	[0.00]	[0.00]	[0.00]

Notes: Standard errors of means in brackets. ** and *** indicate significance at the 5% and 1% level, respectively.

key variable by single- and multi-shop firms, and conduct t-test for the mean of the variables of each firms. There is significant mean difference in the dummy for exit, the dummy for increasing the number of shops, and changes in the number of shops conditional on survival. These imply that multi-shop firms are more likely to increase the number of shops more, and have a lower exit rate. However, conditional on survival, single-store firms increase more the number of shops, though this has a mechanical component as this variable cannot take a negative number for single-store firms. Also, the probability of owning a store on the corner is higher for multi-store firms. However, this is mechanically true in the sense that the more number of shops a firm owns, the probability the firm owns at least one shop with a certain characteristics has to increase. The number of trade group affiliations is higher for multi-shop firms than single-shop ones, suggesting that firms tend to extend their shops with the

increase of own diversity. Note that the fraction of the firms from the same trade groups in the neighborhood region is higher for the multi-shop firms, but it should not be interpreted as evidence of a violation of the randomization assumption. Firms would be likely to find a higher fraction of the firms of the same type if firms belong to the trade groups with more affiliated firms and if firms themselvels belong to more trade groups, even under a completely random assignment of locations. In the following section, we provide the formal test of randomization taking these factors into consideration.

4 Validity of Randomization

The key assumption for our identification strategy is that the assignment of locations is random. In this section, we provide several types of test to confirm the assumption.

4.1 Balance test

The random assignment of locations predicts that the neighborhood variables should not be systematically correlated with firm i's characteristics within the lottery blocks.[19] We check this correlation by OLS. The left hand side variables are the key neighborhood variables, neighborhood diversity, fraction of multi-shop firms, and fraction of firms in the same trade group, and the right hand side variables are firm i's characteristics. Note that the neighborhood characteristics could be correlated with firm i's characteristics mechanically, especially, with the fraction of the firms in the same trade group. Since the number of firms in each trade group is different, the probability that firm i's neighborhood has firms from the same trade group depend on the total number of firms in the trade group as a whole, even if the location assignment is purely random. To control for this mechanical correlation, we include the market-level (not region-specifc) fraction of the firms of the trade group of firm i over all the firms in the market as a predicted neighborhood variable. Results are shown in Table 4. In Column (1), we regress neighborhood diversity on the characteristics of the firm. The coefficient on the dummy indicating whether firm i belongs to the Sushi trade group is negative and statitstically significant at the 10 percent level. But other than this variable, none of the key

[19] Neighborhood variables can be correlated with firm characteristics across the lottery blocks because many of firms can choose a block unless they did not get the desired block at the preliminary lottery.

Table 4: Balance test results

	(1)	(2)	(3)
Dependent	Neighborhood diversity	Fraction of multi-store firms	Fraction of firms from same trade group
Dummy for multiple shops	-0.105	-0.00739	0.00493
	(0.112)	(0.0104)	(0.00736)
Corner	-0.0966	-0.00529	0.0115
	(0.0967)	(0.00475)	(0.00786)
Own diversity	0.661	0.0257	0.0542
	(0.594)	(0.0361)	(0.0383)
Enkanmono	-0.287	0.00642	0.0259
	(0.626)	(0.0291)	(0.0380)
Octopus	0.524	-0.0341	0.0155
	(0.651)	(0.0465)	(0.0461)
Aimono	-0.197	-0.0289	-0.00176
	(0.521)	(0.0331)	(0.0393)
Enkai	-0.264	-0.0134	0.00396
	(0.387)	(0.0220)	(0.0289)
Enyo	-0.0563	-0.0188	0.0372
	(0.976)	(0.0465)	(0.0615)
Kinkai	-0.673	0.00456	-0.00344
	(0.416)	(0.0273)	(-0.0300)
Sushi	-0.371*	-0.0109	0.0159
	(0.215)	(0.0118)	(0.0263)
Renseihin	-0.0722	-0.032	0.0105
	(0.560)	(0.0323)	(0.0366)
Tansui	-0.151	-0.0291	0.0216
	(0.779)	(0.0377)	(0.0521)
Hokuyo	-0.435	-0.0174	0.0648
	(0.514)	(0.0288)	(0.0398)
Shrimp	-0.0785	-0.00909	0.0257
	(0.471)	(0.0316)	(0.0407)
Iseebi	-0.596	-0.0457	-0.026
	(0.849)	(0.0412)	(0.0552)
Predicted neighborhood variable	yes	yes	yes
Block dummy	yes	yes	yes
N	1064	1064	1064

Note: Standard errors are clustered at the region level and shown in parentheses. * indicates significance at the 10% level.

firm characteristics are correlated with the diversity of the neighborhood regions. In Columns (2) and (3), we use the fraction of multi-shop firms and that of firms in the same trade group as the dependent variable, respectively. In both estimation results, there is no variable that significantly correlates with the neighborhood variables. These results reassure us of the randomness of the location assignment.

4.2 Dartboard Approach

We check the validity of randomization in another way. If the shop location allocation is random, it should be indistinguishable from the one generated from the "Dartboard approach". If shops are randomly assigned over the space in the market, there should be no agglomeration of specific type of shops in the market. We show that shop locations in the market is randomly assigned by using the agglomeration index proposed in the literature of urban economics. Specifically, we use the bilateral distance approach proposed by Duranton and Overman (2005).[20] Duranton and Overman (2005) propose the way of testing agglomeration of an industry. Intuitively, we first calculate the distribution of the bilateral distances between all the pairs of firms in the focusing industry (in our case, trade group); then, we compare the obtained distribution with counterfactual distributions of bilateral distances generated by the random location assignment of firms.

Formally, let n be the number of shops belonging to the focusing trade group A, and we have $n(n-1)/2$ number of unique bilateral distances between shops in the trade group. Let d_{ij} be the linear distance between shops i and j.[21] The K-density estimator of bilateral distances at any distance d is

$$\hat{K}_A(d) = \frac{1}{n(n-1)h} \sum_{i=1}^{n-1} \sum_{j=i+1}^{n} f\left(\frac{d - d_{ij}}{h}\right),$$

[20] Dartboard approach was initially developed by Ellison and Glaeser (1997), which calculates an agglomeration index using a fixed geographical unit. We calculated also their agglomeration and coagglomeration indices using our neighborhood region as the unit. All the indices are close to zero. We choose to report the results from the bilateral distance approach proposed by Duranton and Overman (2005) because this approach allows us to test the random allocation hypothesis as the null hypothesis and because the approach is the standard technique to test the concentration using micro-geographic data as we do now.

[21] The distance here is calculated based on the unique x and y coordinates on stalls. From right to left, we assign integer from one to maximum number of stalls in rows as x coordinate, and from outside to inside, we similarly assign integers as y coordinate for each stall. Based on this x and y coordinates, we calculate the Eucledian distance as the bilateral distance between shops.

where h is the bandwidth set as the optimal bandwidth as proposed by Silverman (1986), and f is the Gaussian kernel function.

Then, we consider the case that shops randomly assigned on the market by simulation. In the simulation, we randomly assign n shops' locations on overall sites of shops in the market, and estimate the bilateral distance distribution under the simulated location distributions. By iterating this trial 1000 times, we construct global confidence bands, i.e., an upper confidence band $K_A^U(d)$ and lower confidence band $K_A^L(d)$ so that of the 1,000 randomly drawn K-densities, 99% lie below the upper band and the other 99% lie above the lower band over the entire distance range that we focus on, $[0, d_{max}]$.[22]If $\hat{K_A}(d) > K_A^U(d)$ for at least one $d \in [0, d_{max}]$, trade group A is defined as globally localized at the 1% confidence level. On the other hand, if $\hat{K_A}(d) < K_A^L(d)$ for at least one, and trade group A is not defined as localized, we define trade group A as globally dispersed at the 1% level. In other words, if the estimated K-density locates between the upper and lower confidence bands, we can state that the null hypothesis that the shops in trade group A are randomly allocated is not rejected at the one percent level.

Neighborhood effects might arise not only within a same trade group but also across pairs of different trade groups. As the anecdotal episodes mentioned, Sushi shops may benefit from Tuna shops closely located, and if so, Sushi shops may choose their locations close to Tuna shops. To test the possibility of concentration of shops between trade groups, we also conduct the test for coagglomeration proposed by Duranton and Overman (2005).

To test the coagglomerations, consider trade group A, with n_A firms and trade group B with n_B firms. We calculate all the bilateral distances between firms in trade groups A and B. Thus, the K-density estimator is modified as follows,

$$\hat{K}_{AB}(d) = \frac{1}{n_A n_B h} \sum_{i=1}^{n_A} \sum_{j=1}^{n_B} f\left(\frac{d - d_{ij}}{h}\right).$$

Similar to the single trade group concentration, we can construct the confidence bands by counterfactual simulations that locations of shops both in trade groups A and B are randomly assigned.

As we mentioned, the location lotteries are conducted in two steps, and in the first step,

[22]We set the threshold value of the maximum distance d_{max} as the median distance between all pairs of all the industry as Duranton and Overman (2005) suggested.

shops can choose their preferable blocks. In this sense, the choice of blocks can not be random. To address this issue, we conduct the analysis within lottery block. That is, we restrict shops in a trade group in a block, then we test the agglomeration of them. Thus, the results are obtained by the combination of trade groups and blocks. Results are shown in Table 5 .

Table 5: Results on the test for agglomeration and coagglomeration

	Number of (pairs of) trade groups	Number of agglomerated trade groups (%)
Agglomeration	31	0 (0)
Coagglomeration	192	5 (2.60)

On agglomeration, there are 31 testable combinations of trade group and block.[23] There is no trade group significantly agglomerated at the one percent level. On the other hand, on coagglomeration, 2.6 percent of the pairs of trade groups are significantly coagglomerated in several blocks. In terms of the coagglomeration, a few pair of trade groups are co-located in certain blocks.[24]

Furthermore, to check the overall tendency of the allocation of shops, we also conduct analysis pooling the trade groups. That is, we calculate the bilateral distances between firms in each trade group, then we pool all the calculated bilateral distances and estimate the K-density. The K-density for agglomeration is modified as follows.

$$\hat{K}_{\text{agg}}(d) = \frac{1}{h \sum_{A \in \mathfrak{A}} n_A(n_A - 1)} \sum_{i=1}^{n_A - 1} \sum_{j=i+1}^{n_A} f\left(\frac{d - d_{ij}}{h}\right),$$

where $\mathfrak{A}$ is the set of trade groups. On the counterfactual simulation, we reshuffle all shops in all the trade groups at once in each trial.

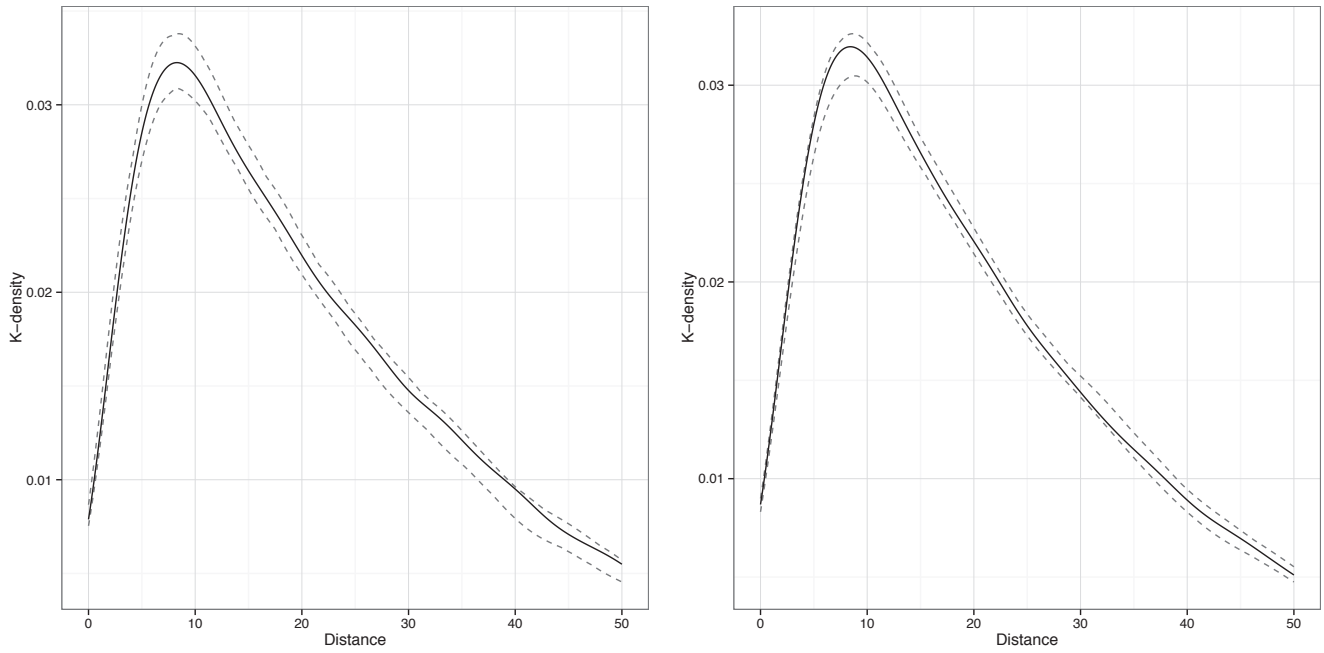
Similarly, we also conduct analysis for coagglomeration pooling the pairs of trade groups. In this case, we calculate bilateral distances between firms in each pair of trade groups, then we pool all the calculated bilateral distances and estimate the K-density as follows,

$$\hat{K}_{\text{coagg}}(d) = \frac{1}{h \sum_{\{A,B\} \in \mathfrak{A} \times \mathfrak{A}} n_A n_B} \sum_{i=1}^{n_A} \sum_{j=1}^{n_B} f\left(\frac{d - d_{ij}}{h}\right).$$

[23] Some combinations have the number of observations too small for this test to be feasible.

[24] We conducted additional analysis where we run the regressions of a dummy indicating if there is a shop of trade group g within next K shops on the set of trade group dummies and block fixed effects. We find almost no statistically significant coefficients for any group g and for K between 1 and 10. The results are available upon request.

The results are shown in the Figure 5.



(a) Agglomeration

(b) Coagglomeration

Figure 5: Results of pooled analysis

Figure 5a shows the result of agglomeration and Figure 5b shows the result of coagglomeration. In both figures, estimated K-densities locates inside the confidence bands. These imply that the location distribution of shops in the Tsukiji fish market are not different from the random allocation overall. In sum, even though a few pairs of trade groups in specific blocks are significantly coagglomerated, in overall, the location pattern of shops are not different from the random allocations.

5 Results

5.1 Baseline results

We show the results on the estimation of neighborhood effects. The results on the diversity hypothesis (Hypothesis 1) is shown in Table 6. In Column (1), we use the change in the number of shops as the dependent variable. The coefficient on the neighborhood diversity variable is positive and statistically significant. This implies that neighborhood diversity has

a positive spillover effect on single-shop firms. On the other hand, the coefficient on the interaction term between neighborhood diversity and the multi-shop dummy is negative and statistically significant. The magnitudes of the two imply that the diversity of neighborhood firms negatively affects the performance of multiple-shop firms. These together suggest that the diversity of neighborhood firms has positive effects, through consumers' love of variety preference, on single shop firms who would be specialized in a certain fish specialties, while the competition effect dominates this positive spillover effect for multi-shop firms who would be diversifying their fish specialties. In Column (2) we use the exit dummy as the dependent variable. No coefficient of interest is significant, suggesting that the impact of the diversity of the neighborhood is not big enough to affect exit, which is the most extreme outcome for firms. Finally, in Column (3) we use the shop increase dummy as the dependent variable. Results are similar to that in Column (1). In addition to the effect of diversity, having a shop on the corner significantly helps firms to increase the number of shops, which is consistent with the perception of the intermediate wholesalers.

Table 6: Results on diversity

	(1)	(2)	(3)
	Δ no. of shops	Exit	Shop increase dummy
Corner dummy	0.172**	-0.0279	0.0698**
	(0.0725)	(0.0238)	(0.0287)
Own diversity	-1.198**	0.0153	-0.147
	(0.576)	(0.0955)	(0.0966)
Multi-shop dummy	0.351**	-0.00459	0.284**
	(0.163)	(0.110)	(0.130)
Neighborhood diversity	0.0256***	-0.00237	0.0169***
	(0.00849)	(0.00752)	(0.00591)
Neighborhood diversity	-0.0565***	-0.00697	-0.0254**
$\times$ Multi-shop dummy	(0.0193)	(0.0135)	(0.0101)
Block FE	yes	yes	yes
Trade group FE	yes	yes	yes
Year	1990	1990	1990
N	951	1040	1005

Note: Clustered standard errors by neighborhood region are in parentheses.
** and *** indicate significance at the 5% and 1% level, respectively.
Own diversity is defined as the number of trade groups that a firm belongs to.
Neighborhood diversity is defined as the total number of unique trade groups of other firms in the same neighborhood region.

Next, we investigate the effects of having more firms in the same trade group in the neighborhood. Results are shown in Table 7. As in Table 6, Column (1) shows the result using the difference in the number of shops as the dependent variable. Similar to the previous result on diversity, the coefficient on the fraction of same trade group is positive, and the coefficient for the interaction term between fraction of same trade group and multi-shop dummy is negative, but either coefficient is not statistically significant. The spillover effects from neighborhood firms in the same trade group would be smaller than the other types of spillover effects. In Column (2), we use the exit dummy as the dependent variable. Again, no coefficient of interest is significant. Finally, in Column (3), we use the shop increase dummy as the dependent variable. In this estimation, the coefficient on the fraction of the same trade group remains positive but now statistically significant. The result that the fraction of firms in the same trade group in neighborhood region positively affects the performance of single shop firms is consistent with the ideal variety idea. That is, a cluster of firms from the same trade group attracts customers who search products matched to their ideal characteristics, as such a cluster reduces the seach cost, and increases firm performance. However the magnitude of the coefficient on the interaction term with the multi-shop firm dummy suggests that this effect cannot be observed for multi-shop firms who are not specialized in the certain fish specialties. Possibly, competition cancels the positive effect of the agglomeration for them.

As the third analysis, we investigate the spillover effects from multi-shop firms. Results are shown in Table 8. Columns (1)-(3) show the results using the same order of the dependent variables as the two previous tables. For the change in the number of shops in Column (1), the coefficient on the fraction of multi-store firms in the neighborhood region is positive, but not statistically significant. On the other hand, the coefficient on its interaction term with the multi-shop dummy is negatively and statistically significant. Column (2) shows that we do not find any results for the case of exit, as has been the case for other hypotheses. Column (3) shows that the fraction of multi-shop firms positively affect the performance of single-shop firms while it has a negative effect on multi-shop firms and that both effects are statistically significant. These together imply that multi-shop firms intensively competitive each other, but single-shop firms likely being specialized in a certain fish specialty can benefit from the presence of multi-shop firms through the Tsuidegai effect.

Finally, we include all the neighborhood variables and interaction terms together in one

Table 7: Results on fraction of same trade group

	(1)	(2)	(3)
	Δ no. of shops	Exit	Shop increase dummy
Corner dummy	0.174**	-0.167	0.356***
	(0.0733)	(0.168)	(0.125)
Own diversity	-1.181**	0.113	0.351
	(0.584)	(0.571)	(0.652)
Multi-shop dummy	-0.0751	-0.243	0.426**
	(0.0865)	(0.240)	(0.217)
Fraction of firms of the same trade group	0.179	0.265	1.631**
	(0.211)	(0.592)	(0.732)
Fraction of firms of the same trade group	-0.128	-0.587	-1.285
$\times$ Multi-shop dummy	(0.374)	(0.956)	(0.947)
Block FE	yes	yes	yes
Trade group FE	yes	yes	yes
Year	1990	1990	1990
N	951	1040	1005

Note: Clustered standard errors by neighborhood region are in parentheses.
** and *** indicate significance at the 5% and 1% level, respectively.
Own diversity is defined as the number of trade groups that a firm belongs to.

Table 8: Results on multi-shop

	(1)	(2)	(3)
	Δ no. of shops	Exit	Shop increase dummy
Corner dummy	0.173**	-0.170	0.334***
	(0.0712)	(0.171)	(0.125)
Own diversity	-0.485**	0.164	-0.707
	(0.236)	(0.582)	(0.591)
Multi-shop dummy	0.227	-1.054	1.159***
	(0.176)	(0.761)	(0.400)
Fraction of multi-shop firms	0.203	-0.962	1.510**
	(0.201)	(1.264)	(0.698)
Fraction of multi-shop firms	-0.934**	1.958	-2.899***
$\times$ Multi-shop dummy	(0.464)	(1.990)	(0.967)
Block FE	yes	yes	yes
Trade group FE	yes	yes	yes
Year	1990	1990	1990
N	951	1040	1005

Note: Clustered standard errors by neighborhood region are in parentheses.
** and *** indicate significance at the 5% and 1% level, respectively.
Own diversity is defined as the number of trade groups that a firm belongs to.

Table 9: Results on all the neighborhood variables

	(1)	(2)	(3)
	Δ no. of shops	Exit	Shop increase dummy
Corner dummy	0.168**	-0.0270	0.0627**
	(0.0728)	(0.0236)	(0.0281)
Own diversity	-1.218**	0.0243	-0.158*
	(0.575)	(0.0947)	(0.0890)
Multi-shop dummy	0.843***	-0.0707	0.781***
	(0.227)	(0.157)	(0.138)
Neighborhood diversity	0.0316***	-0.00298	0.0226***
	(0.00896)	(0.00775)	(0.00694)
Neighborhood diversity	-0.0648***	-0.00975	-0.0328***
$\times$ Multi-shop dummy	(0.0188)	(0.0132)	(0.0106)
Fraction of multi-shop firms	0.299*	-0.159	0.298***
	(0.172)	(0.219)	(0.104)
Fraction of multi-shop firms	-1.033**	0.348	-0.531***
$\times$ Multi-shop dummy	(0.418)	(0.352)	(0.159)
Fraction of firms of the same trade group	0.258	0.0547	0.306**
	(0.213)	(0.0943)	(0.124)
Fraction of firms of the same trade group	-0.288	-0.156	-0.304*
$\times$ Multi-shop dummy	(0.380)	(0.149)	(0.163)
Year	1990	1990	1990
N	951	1040	1005

Note: Clustered standard errors by neighborhood region are in parentheses.
** and *** indicate significance at the 5% and 1% level, respectively.
Own diversity is defined as the number of trade groups that a firm belongs to.
Neighborhood diversity is defined as the total number of unique trade groups of other firms in the same neighborhood region.

set of regressions. Results are shown in Table 9. Results are qualitatively unchanged. The three neighborhood variables positively affect performance of single-shop firms, while they negatively affect the performance of multi-shop firms. Overall, we find strong support for the diversity effect: the diversity of firms positively affects the performance of single-shop firms, who are likely to be specialized, because of the love of variety channel. We also find support, though with somewhat weaker confidence as we find statistically significant effects only for the shop increase dummy, for the ideal variety story in which a higher fraction of firms belonging to the same trade group also positively affects the performance of single-shop firms. These together provide evidence that certain neighborhoods with less search cost for buyers help firms to grow. The results also suggest the existence of strong competition among multi-shop firms.

5.2 Alternative Measures of Own Specialization/Diversification

In the previous analysis, we find strong effects of the diversity of firms in the neighborhood. We conduct robustness checks on the choice of the specialization/diversification variable. In our main analysis above, we used the multi-shop firm dummy as a proxy for the diversification of the firms. However, the number of the shops does not necessary mean more diversification. Alternatively, we use the number of trade groups that firms affiliate as another measure of diversification. Given the fact that the trade groups are associated with fish specialties, it is plausible to assume that the more number of trade groups a firms belongs to, it operates in more lines of business. Table 10 shows the result. Similarly to the specification of Table 9, we include all the three neighborhood variables and interaction terms now with the number of the trade groups the firm affiliates. Neighborhood diversity still has a strong significant effect on firm performance. Overall, the qualitative results are unchanged with this alternative measure of diversification.

As the measure of specialization/diversification of a firm, we also consider a further alternative measure based on the identity of the trade group that the firm affiliates. The number of the variety of fish handled is different across trade groups. Especially, Kinkai and Enkai trade groups handle a very wide variety of fish.[25] On the other hand, other trade groups are

[25]There two groups later merged to form a new group called "Sengyo", which means just fresh fish. The generic nature of its name suggests that firms belonging to these groups are not specialized.

Table 10: Results on all the neighborhood variables

	(1)	(2)	(3)
	Δ no. of shops	Exit	Shop increase dummy
Corner dummy	0.180**	-0.0271	0.0729**
	(0.0737)	(0.0240)	(0.0306)
Own diversity	-0.309	-0.0116	0.395***
	(0.671)	(0.193)	(0.126)
Multi-shop dummy	-0.101**	-0.0569**	0.0241
	(0.0454)	(0.0240)	(0.0216)
Neighborhood diversity	0.120***	0.00236	0.0398***
	(0.0275)	(0.0154)	(0.0124)
Neighborhood diversity	-0.101***	-0.00690	-0.0279***
$\times$ Own diversity	(0.0253)	(0.0119)	(0.0103)
Fraction of multi-shop firms	0.424	-0.294	0.551***
	(0.419)	(0.304)	(0.179)
Fraction of multi-shop firms	-0.465	0.203	-0.433***
$\times$ Own diversity	(0.405)	(0.223)	(0.148)
Fraction of firms of the same trade group	0.569	0.00705	0.307**
	(0.366)	(0.146)	(0.147)
Fraction of firms of the same trade group	-0.405*	-0.0155	-0.127
$\times$ Own diversity	(0.236)	(0.0910)	(0.0912)
Year	1990	1990	1990
N	951	1040	1005

Note: Clustered standard errors by neighborhood region are in parentheses.
*, ** and *** indicate significance at the 10%, 5% and 1% level, respectively.
Own diversity is defined as the number of trade groups that a firm belongs to.
Neighborhood diversity is defined as the total number of unique trade groups of other firms in the same neighborhood region.

Table 11: Results on all the neighborhood variables

	(1)	(2)	(3)
	Δ no. of shops	Exit	Shop increase dummy
Corner dummy	0.175**	-0.0239	0.0670**
	(0.0734)	(0.0242)	(0.0293)
Own diversity	-0.423**	-0.0663	-0.111
	(0.0231)	(0.0105)	(0.0993)
Multi-shop dummy	0.255	-0.150	0.287***
	(0.172)	(0.100)	(0.105)
Own specialization	-0.390*	-0.0950	-0.131
	(0.199)	(0.124)	(0.131)
Neighborhood diversity	-0.0317*	-0.00165	0.0398***
	(0.0174)	(0.00921)	(0.0124)
Neighborhood diversity	0.0541**	-0.00497	-0.00744
$\times$ Own specialization	(0.0214)	(0.00954)	(0.00896)
Fraction of multi-shop firms	0.264	-0.162	0.290***
	(0.204)	(0.217)	(0.109)
Fraction of multi-shop firms	-0.1019**	0.336	-0.565***
$\times$ Multi-shop dummy	(0.463)	(0.343)	(0.169)
Fraction of firms of the same trade group	-0.124	0.0234	0.172
	(0.366)	(0.0980)	(0.105)
Fraction of firms of the same trade group	0.391	-0.0401	-0.105
$\times$ Own specialization	(0.382)	(0.129)	(0.126)
Year	1990	1990	1990
N	951	1040	1005

Note: Clustered standard errors by neighborhood region are in parentheses.
*, ** and *** indicate significance at the 10%, 5% and 1% level, respectively.
Own diversity is defined as the number of trade groups that a firm belongs to.
Own specialization is defined as a dummy indicating a firm has only one affiliation to trade groups other than Kinkai and Enkai, and zero otherwise.
Neighborhood diversity is defined as the total number of unique trade groups of other firms in the same neighborhood region.

Table 12: Results on using HHI as a measure of diversity

	(1)	(2)	(3)
	Δ no. of shops	Exit	Shop increase dummy
Corner dummy	0.162**	-0.0269	0.0617**
	(0.0723)	(0.0242)	(0.0289)
Own diversity	-1.149*	0.0296	-0.143
	(0.580)	(0.0952)	(0.0941)
Multi-shop dummy	-0.197	-0.186	0.0818
	(0.274)	(0.125)	(0.116)
Neighborhood diversity (HHI)	-0.921***	-0.0393	-0.786***
	(0.337)	(0.227)	(0.257)
Neighborhood diversity (HHI)	2.241**	0.343	0.922**
$\times$ Multi-shop dummy	(1.113)	(0.418)	(0.376)
Fraction of multi-shop firms	0.215	-0.151	0.227**
	(0.176)	(0.212)	(0.0988)
Fraction of multi-shop firms	-0.786*	0.366	-0.445***
$\times$ Multi-shop dummy	(0.425)	(0.348)	(0.161)
Fraction of firms of the same trade group	0.271	0.0629	0.357***
	(0.222)	(0.0959)	(0.132)
Fraction of firms of the same trade group	-0.276	-0.143	-0.303*
$\times$ Multi-shop dummy	(0.365)	(0.161)	(0.160)
Year	1990	1990	1990
N	951	1040	1005

Note: Clustered standard errors by neighborhood region are in parentheses.
*, ** and *** indicate significance at the 10%, 5% and 1% level, respectively.
Own diversity is defined as the number of trade groups that a firm belongs to.
Neighborhood diversity is defined as Herfindahl Hirschman Index (HHI) of the number of shops by
trade groups of neighborhood firms

specialized in certain types of fishes. Based on this background, we construct a dummy for specialization that equals to one if a firm has only one affiliation to trade groups other than Kinkai and Enkai, and zero otherwise. Table 11 shows the result. Columns (1) and (3) show that the diversity of neighborhood positively affects firm performance only if they are specialized. Thus, our results that the effect of neighborhodd diversity is positive for specialized firms are robust to the choice of the specialization measure.

5.3 Alternative Measures of Neighborhood Diversity

Next, we use an alternative measure of neighborhood diversity. Instead of using the number of unique trade groups that neighborhood firms affiliate, we use Herfindahl Hirschman Index

(HHI) of the number of shops by trade groups of neighborhood firms as an inverse measure of diversity. The results are shown in Table 12. Results are unchanged from the baseline results even if we use the HHI as an alternative (inverse) measure of neighborhood diversity. Thus, our results that the effect of neighborhood diversity is positive for specialized firms are robust to the choice of the neighborhood diversity measure.

5.4 Alternative definitions of neighborhood areas

In the above analysis, we use the neighborhood region as two rows and columns of stalls between large streets and share the same horizontal corridor. However, as we mentioned in the institutional background of the location lottery, a part of horizontal neighbors might be endogenously determined. Though we do not detect a sign of endogeneity in our analysis of the validity of randomization, we provide an additional analysis in which we restrict neighborhood regions to only neighboring firms facing across the horizontal corridor. This means that we throw away firms on the same raw from the neighborhood. As we write before, the characteristics of neighboring firms facing across the horizontal corridor has almost no room for being endogenous for a firm because they are typically far apart in lottery numbers. The results are shown in Table 13. Columns (1) and (3) show that the diversity of neighborhood positively affects firm performance only if they are single-shop firms. Thus, our main findings on diversity are still observed for the definition of a neighborhood region for which we can be sure about exogeneity. This result is reassuring. Note that we also still observe the positive impact of the fraction of the firms from the same trade group on single-shop firms if we use the dummy for increasing the number of shops as the dependent variable. We do not find any more the impact of the fraction of multi-shop firms. This may be because some region-level variations are lost due to use of less information.

Finally, we provide a type of "placebo test" for our mechanism, exploiting the background information on the structure of the market. That is, firms share their customer through the horizontal corridor they face each other. On the other side of the stalls, which is the back side of the shops, there is no corridor where customers walk around. Firms share only backyards of the stalls in the next row. This means that for each firm there is a set of firms that with whom it shares (or competes for) buyers and there is another set of firms equally close with much less

Table 13: Results using the neighbors restricting to the ones facing across corridor

	(1)	(2)	(3)
	Δ no. of shops	Exit	Shop increase dummy
Corner dummy	0.170**	-0.0258	0.0618**
	(0.0684)	(0.0228)	(0.0297)
Own diversity	-0.489*	0.0178	-0.163*
	(0.248)	(0.0749)	(0.0937)
Multi-shop dummy	0.205	-0.0671	0.553***
	(0.235)	(0.106)	(0.154)
Neighborhood diversity	0.0223**	-0.0135	0.0252***
	(0.00853)	(0.0122)	(0.00639)
Neighborhood diversity	-0.0389	0.00558	-0.0417***
$\times$ Multi-shop dummy	(0.0252)	(0.0172)	(0.0106)
Fraction of multi-shop firms	0.0718	0.115*	0.107
	(0.116)	(0.0655)	(0.0804)
Fraction of multi-shop firms	-0.110	-0.0200	-0.0899
$\times$ Multi-shop dummy	(0.280)	(0.112)	(0.116)
Fraction of firms of the same trade group	0.143	-0.0584	0.209***
	(0.137)	(0.0910)	(0.0809)
Fraction of firms of the same trade group	-0.122	-0.00647	-0.323***
$\times$ Multi-shop dummy	(0.276)	(0.140)	(0.107)
Year	1990	1990	1990
N	955	1044	1009

Note: Clustered standard errors by neighborhood region are in parentheses.
*, ** and *** indicate significance at the 10%, 5% and 1% level, respectively.
Own diversity is defined as the number of trade groups that a firm belongs to.
Neighborhood diversity is defined as the total number of unique trade groups of other firms in the same neighborhood region.

Table 14: Results using the neighbors restricted to the ones in the back: Placebo test

	(1)	(2)	(3)
	Δ no. of shops	Exit	Shop increase dummy
Corner	0.150**	-0.199	0.292*
	(0.0723)	(0.175)	(0.152)
Own diversity	-0.989	0.0865	-1.259
	(0.651)	(0.444)	(1.125)
Multi-shop dummy	-0.235	0.111	0.554
	(0.228)	(0.615)	(0.624)
Neighborhood diversity	0.00629	-0.0888	0.0866*
	(0.0100)	(0.0613)	(0.0486)
Neighborhood diversity	-0.00227	-0.0356	-0.0904
$\times$ Multi-shop dummy	(0.0325)	(0.0996)	(0.0855)
Fraction of multi-shop firms	-0.0415	0.798	-0.133
	(0.0816)	(0.543)	(0.436)
Fraction of multi-shop firms	0.0894	-0.529	0.314
$\times$ Multi-shop dummy	(0.207)	(0.908)	(0.649)
Fraction of firms of the same trade group	-0.134	-0.139	-0.0764
	(0.173)	(0.543)	(0.579)
Fraction of firms of the same trade group	0.553	0.0435	0.000916
$\times$ Multi-shop dummy	(0.364)	(0.707)	(0.656)
Year	1990	1990	1990
N	802	888	824

Note: Clustered robust standard errors by neighborhood region are in parentheses.
*, ** and *** indicate significance at the 10%, 5% and 1% level, respectively.
Own diversity is defined as the number of trade groups that a firm belongs to.
Neighborhood diversity is defined as the total number of unique trade groups of other firms in the same neighborhood region.

tendency of sharing (or competing for) buyers. Thus, we predict that there is no neighborhood effect from neighborhood firms in the back if the neighborhood spillover effects come from the buyer sharing mechanism. If the other mechanism like knowledge spillovers are the source of the neighborhood effects, we may still observe the neighborhood effects even from neighboring firms in the back, because through the backyards, firm owners and workers contact with each other. The results are shown in Table 14. The results suggest that we have almost no evidence of neighborhood effects using this alternative definition of neighborhood. Only the coefficient for neighborhood diversity in Column (3) is significantly positive at the 10 % level. The other neighborhood effects totally disappeared. This result is consistent with the mechanism of the neighborhood effects we consider. Namely, the diversity of the neighborhood and the fraction

of similar firms in the neighborhood affect firm performance because of buyers.

6 Conclusion and Plan for Future Analysis

This paper empirically investigates neighborhood spillover effects in the Tokyo Tsukiji Fish Market. We address the identification difficulty coming from the self-selection of firm location by exploiting a unique feature of their locations within the market: their locations are determined every 4-10 years by relocation lotteries. Using this feature that the location of firms is randomly determined, we estimate the causal effect of the characteristics of neighboring firms on firm performance.

We find that both the diversity of the neighboring firms and the fraction of neighboring firms selling similar products positively affect the performance of specialized firms. Additionally, we find some evidence that the share of large firms in the neighborhoods decreases the performance of similarly large firms. Then, we demonstrate that our results are robust when we use alternative measures of neighborhood diversity and specialized firms. Finally, we present the analysis changing the definition of the neighborhood. We show that firm performance is influenced by the characteristics of other firms facing it across a corridor (i.e., sharing buyers), but not by the characteristics of other firms equally close but on a different corridor from the firm (i.e., not sharing buyers). This confirms that the neighborhood effects we find arise from the interaction of firms through their buyers.

We plan to extend our analysis to more years with more cycles of the lotteries (and thus shop relocations). We also plan to use the Census of Commerce so that we can use more detailed firm-level information, such as sales and employment, which would allow us to enrich both the dependent variables and the independent variables.

References

[1] Arakawa, Kiyoshi. 2000. A Model of Shopping Centers. *Journal of Regional Science*, 46, 969-990.

[2] Azoulay, Pierre, Joshua G. Zivin and Jialan Wang. 2010. Superstar Extinction. *Quarterly Journal of Economics*, 2010, 125, 549-589.

[3] Bandiera, Oriana, Iwan Barankay and Imran Rasul- 2010. Social Incentives in the Workplace. *Review of Economic Studies*, 77, 417-458.

[4] Bayer, Patrick, Randi Hjalmarsson and David Pozen. 2009. Building Criminal Capital behind Bars: Peer Effects in Juvenile Corrections. *Quarterly Journal of Economics*, 2009, 124, 105-147.

[5] Benmelech, Efraim, Nittai Bergman, Anna Milanez and Vladimir Mukharlyamov. 2014. The Agglomeration of Bankruptcy. NBER WP 20254.

[6] Bernard, Andrew B., Andreas Moxnes and Yukiko Saito U. 2016. Production Networks, Geography and Firm Performance, Mimeo.

[7] Bester, Theodore C. 2004. Tsukiji: the Fish Market at the Center of the World. University of California Press. Berkeley.

[8] Brown, Jenifer. 2011. Quitters Never Win: The (Adverse) Incentive Effects of Competing with Superstars. *Journal of Political Economy*, 119, 982-1013.

[9] Burchardi, Konrad B. and Tarek A. Hassan. 2013. The Economic Impact of Social Ties: Evidence from German Reunification. *Quarterly Journal of Economics*, 128, 1219-1271.

[10] Chyn, Eric. 2016. Moved to Opportunity: The Long-Run Effect of Public Housing Demolition on Labor Market Outcomes of Children. Mimeo.

[11] Cosman, Jacob. 2014. Industry Dynamics and the Value of Variety in Nightlife: Evidence from Chicago. Mimeo.

[12] Courtue, Victor. 2015. Valuing Consumption Benefits of Urban Density. Mimeo.

[13] Davis, Donald R., Jonathan I. Dingel, Joan Monras and Eduardo Morales. 2016. How Segregated Is Urban Consumption? Mimeo.

[14] Davis, Donald R. and David E. Weinstein. 2002. Bones, Bombs, and Break Points: the Geography of Economic Activity. American Economic Review, 1269-1289.

[15] Duranton, Gilles and Henry G. Overman. 2005. Testing for Localization Using Micro-geographic Data. *Review of Economic Studies*, 1077-1106.

[16] Ellison, Glenn and Edward L. Glaeser. 1997. Geographic Concentration in US Manufacturing Industries: A Dartboard Approach. *Journal of Political Economy*, 105, 889-927.

[17] Faber, Benjamin. 2014. Trade Integration, Market Size, and Industrialization: Evidence from China's National Trunk Highway System. *Review of Economic Studies*, 81, 1046-1070.

[18] Feyrer, James. 2009. Distance, Trade, and Income - The 1967 to 1975 Closing of the Suez Canal as a Natural Experiment. NBER WP 15557.

[19] Greenstone, Michael, Richard Hornbeck and Enrico Moretti. 2010. Identifying Agglomeration Spillovers: Evidence from Winners and Losers of Large Plant Openings. *Journal of Political Economy*, 118, 536-598.

[20] Henkel, Joachim, Konrad Stahl and Uwe Walz. 2000. Coalition Building in a Spatial Economy. *Journal of Urban Economics*, 47, 136-163.

[21] Hornbeck, Richard and Daniel Keniston. 2014. Creative Destruction: Barriers to Urban Growth and the Great Boston Fire of 1872. NBER WP 20467.

[22] Jardim, Eduardo. 2015. All in the Mix: Spillovers and the Agglomeration of Neighborhood Retail. Mimeo.

[23] Kling, Jeffery R., Jeffery B. Liebman and Lawrence F. Katz. 2007. Experimental Analysis of Neighborhood Effects. *Econometrica*, 75, 83-119.

[24] Kondo, Ayako and Masahiro Shoji. 2015. Peer Effects in Employment Status: Evidence from Housing Lotteries for Forced Evacuees in Fukushima. Mimeo.

[25] Konishi, Hideo. 2005. Concentration of Competing Retail Stores. *Journal of Urban Economics*, 58, 488-512.

[26] Mas, Alexandre and Enrico Moretti. Peers at Work. *American Economic Review*, 99, 112-145.

[27] Nakajima, Kentaro. 2008. Economic Division and Spatial Relocation: The Case of Postwar Japan. *Journal of the Japanese and International Economies*, 2008, 22, 383-400.

[28] Redding, Stephen J. and Daniel M. Sturm. 2008. The Costs of Remoteness: Evidence from German Division and Reunification. *American Economic Review*, 98, 1766-97.

[29] Redding, Stephen, J. and Daniel M. Sturm. 2016. Estimating Neighborhood Effects: Evidence from War-time Destruction in London. Mimeo.

[30] Redding, Stephen, J. and Daniel M. Sturm and Nikolaus Wolf. 2011. History and Industry Location: Evidence from German Airports. *Review of Economics and Statistics*, 93, 814-831.

[31] Shoag, Daniel and Stan Veuger. 2015. Shops and the City. Mimeo.

[32] Silverman, Bernard W. 1986. Density Estimation for Statistics and Data Analysis, Chapman & Hall, London.

[33] Tabuchi, Takatoshi. 2009. Self-organizing Marketplaces. *Journal of Urban Economics*, 2009, 66, 179-185.

[34] Wolinsky, Asher. 1983. Retail Trade Concentration due to Consumers' Imperfect Information. *Bell Journal of Economics*, 14, 275-282.

[35] Yamane, Shoko and Ryohei Hayashi. 2015. Peer Effects among Swimmers. *Scandinavian Journal of Economics*, 117, 1230-1255.