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Roles of Wholesalers in Transaction Networks [*]

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Abstract

Wholesalers are considered to play an important role in ensuring efficient transaction networks. Using unique data on Japanese domestic transactions compiled by Tokyo Shoko Research, we investigate wholesalers' roles in transaction networks for intermediate manufacturing goods. Comparing manufacturing firms transacting directly and those connected indirectly through wholesalers, we find a clear asymmetry in the characteristics of buyer- and seller-side manufacturers that tend to rely on wholesalers. We also examine how transaction distances differ depending on transaction partners, and find that, as compared to manufacturing partners in direct transactions, wholesalers tend to locate closer to their manufacturing buyers and farther from their manufacturing sellers, ceteris paribus. This gives us insights on how wholesalers support transaction networks that connect geographically dispersed manufacturing firms.

Keywords: Wholesaler, Transaction networks, Sellers and buyers, Distance
JEL Classification: L14, L81,R10

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1. Introduction

Wholesalers are considered to play an important role in supporting efficient transaction networks. They are considered to help firms overcome various transaction costs, including search costs as well as monitoring costs. Despite the important roles of wholesalers, we know little about between which firms wholesalers intermediate and which parts of transaction networks are supported by wholesalers. Using unique transaction data, this paper presents stylized facts on transaction networks with and without wholesalers. We also shed light on wholesalers' roles in transactions among spatially dispersed firms by examining relationships between transaction distances and firm characteristics.

Thus far, only a few studies have compared firms transacting directly and those connected indirectly through wholesalers. In the literature of international trade, using a World Bank survey, Ahn et al. (2009) and Bernard et al. (2013) compare firms exporting directly and those exporting indirectly through wholesalers. They find that less productive and smaller firms tend to rely on wholesalers for exporting, suggesting an existence of costs involved with transacting (i.e. exporting) directly that cannot be overcome by small and unproductive firms. Their studies, however, are limited to only the seller's perspective, and no study has incorporated both the perspectives of buyer and seller regarding transactions in the analyses.

Analyses on transaction distances when a transaction involves wholesalers are almost non-existent, and again we find related studies exploring transaction frictions in international trade literature. Using custom data on exports,[1] Ahn et al. (2009) and Crozet et al. (2013) find that, compared to manufacturing exporters, wholesaler exporters deal with markets that are difficult to penetrate, such as small countries and countries with high trade costs.[2] Their findings support the view that, with existence of fixed transaction costs, transacting with many partners and processing a large trade volume in total make wholesalers efficient product distributors. It is possible that domestic transaction networks that connect geographically dispersed firms are also supported by wholesalers playing such roles. Again, the interpretations from these existent studies are limited because their trade data offer characteristics of only sellers (exporters), while transactions are realized by decisions of both buyers and sellers.

In this paper, we use unique data on Japanese domestic transactions compiled by Tokyo Shoko Research (TSR) to examine wholesalers' roles in transaction networks, specifically

[1] The custom data they used are firm product-level.
[2] Consistent observations on importing and exporting are reported in Bernard et al. (2010) based on data matching US export and import transactions with US firm data.

focusing on their roles in connecting manufacturers for intermediate manufacturing good transactions.[3] Taking advantage of our observations of seller-buyer links and both seller and buyer characteristics, we first compare characteristics of manufacturing sellers and manufacturing buyers transacting directly and those connected through wholesalers[4] To our knowledge, our paper is the first to incorporate data from both sellers and buyers in order to understand wholesalers' roles. Our findings show clear asymmetries between manufacturing sellers and manufacturing buyers in their characteristics when they rely on wholesalers, suggesting an importance in distinguishing between wholesalers' roles in procurement and their roles in distribution.

How do wholesalers help some manufacturers to avoid costs of transacting other manufacturers? In this paper, we also sought answers to this question by focusing on examining wholesalers' locations in relation to manufacturing transaction partners. Interestingly, our data show that wholesalers are located closer to their manufacturing buyers and farther from their manufacturing sellers as compared to manufacturers transacting directly with other manufacturers. In the analyses, we examine how a transaction distance is associated with characteristics of a seller and a buyer and how such association changes when either partner is a wholesaler. Our analyses also help us understand wholesalers' roles in supporting spatially dispersed transaction networks.

2. Data

We use firm-level data on buyer-seller transaction links collected by TSR, which regularly surveys firms to maintain its commercial datasets. TSR also uses public information to complement their data. The data comprises two sub datasets; TSR firm dataset (TSR-FD) and TSR transaction-link dataset (TSR-TD). We use the data sets compiled in the year 2006. The 2006 TSR firm dataset includes about 800 thousand firms employing around 26 million workers. Compared with Japanese firm population,[5] the TSR–FD covers a little more than 50% of Japan's firms and about 80% of the nation's employed population. The data provides such firm information as employment, sales, foundation year, number of establishments/factories, and industry code. The TSR–FD also provides the firms' address (i.e., for headquarters), which

[3] Wholesalers' roles may vary widely across depending on the industry of firms relying on wholesalers.
[4] There is a small body of literature on wholesalers' geographical location and market entry. Daunfeldt et al. (2006) and Daunfeldt et al. (2013) find that large local markets attracted Swedish WSL firms from 1990 to 1996.

[5] Source: the 2006 Japanese Establishment and Enterprise Census from the Japanese Ministry of Internal Affairs and Communications

we translate into longitude and latitude in order to calculate distance between transaction partners.[6]

All the firms in the TSR-FD are requested to report their main buyers and sellers (up to 24 firms each).[7] As long as the reported transaction partners are also in the TSR-FD, such records on transaction links are compiled to create TSR-TD (TSR Transaction Data). For the 2006 version of the data we use, about 85% of firms in TSR-FD are included in TSR-TD. Note that, reporting firms are not necessarily main partners of the reported firms unless they are also reported by the firms they reported.[8] We redesign TSR-TD to capture all main and non-main transaction partners in TSR-FD for each firm. While each firm reports only up to 24 buyers (sellers), some firms are reported by many firms, and thus the total number of main and non-main buyer- (seller-) partners can exceed 24 firms. Combined with firm characteristics from TSR-FD, such information on transaction partners allow us to construct various summary variables on partner characteristics for each firm. We also combine the bilateral transaction-link information to understand the structure of transaction networks, identifying not only firms' direct partners but also indirect partners such as their second- and third-tier partners.

Transaction-link data in TSR-TD as a whole

All networks are formed by nodes and links. For transaction networks, nodes are firms, and links are seller-buyer transaction relationships. Which firms are connected by a link, whether firms are connected directly or indirectly, to how many other firms a firm is linked, and what kind of a path (a combination of nodes and links) connects two firms in a network help us characterize the degree to which a firm plays "central" roles in a specific network. Here, to give an overall view on relative positions of WSL (wholesale) and MFG (manufacturing) firms in transaction networks, we employ a standard network analysis technique using two representative "centrality" indices —closeness and betweenness indices.

The closeness index measures how "closely" a firm is connected to other firms by the average degree of separations between the firm and all other firms in a network. The lower level of closeness index for a firm indicates that the firm is connected to other firms with lower degree of separations. The betweenness index measures how "essential" a firm is in connecting

[6] We use the geocoding tool offered by the CSIS of the University of Tokyo, which is available at http://www.csis.u-tokyo.ac.jp/japanese/index.html.

[7] No definition of "main" is provided in the survey. The Japanese word for "main" also means "important." We consider that a main partner is one with which the reporting firm has had a relatively long relationship.

[8] Note that a firm must be included in the survey to report a firm as a main partner. The firms in the TSR data appear as surveyed firms reporting their main partners, firms reported as main partners, or both. Thus, each transaction is considered "main" ("important") by one or both parties; transactions considered main (important) by neither party are not included.

a given two firms. In a network, there can be multiple shortest paths connecting two firms. If many of the shortest paths include a particular firm, the firm can be considered "essential" for connecting the two firms. As such, the betweenness index of a given firm is defined as the total number of the shortest paths between all firm pairs that include the firm discounted by the number of the shortest paths between each firm pair.

We calculate these two indices for each firm in the whole network with 800 thousand firms, which include all industries. An average (median) of betweenness index for a WSL firm is 4.2 (2.6) million and that for a MFG firm is 3.4 (1.2) million. The betweenness index is larger for WSL firms than for MFG firms. This seems to indicate that, as compared to a MFG firm, a WSL firm seems to play a more essential role in connecting other firms, possibly reflecting its intermediary role.[9] On the other hand, we find the closeness index are similar between WSL and MFG firms. It is possible that a MFG firm is connected to other firms as closely as a WSL firm is; this possibly reflects various transaction paths that MFG firms form without involving WSL firms.

Samples to study intermediate MFG good transactions

As we mentioned above, we focus on examining WSL firms' roles in connecting MFG firms for intermediate MFG good transactions and thus limit our sample to transaction links that involve MFG and/or WSL firms. However, unlike direct transactions between MFG firms (MFG&MFG transactions), transactions between an MFG and a WSL firm might not necessarily be made for intermediate MFG goods. Without information on transacted goods in the TSR–TD, however, we have to infer which WSL firms engage in intermediate MFG transactions. In particular, for WSL firms selling to (buying from) MFG firms, we assume that WSL firms that buy (sell) from (to) at least one MFG firm sell (buy) intermediate MFG good. In what follows, we call WSL firms with at least one MFG seller as M–WSL firms and WSL firms with at least one MFG buyer as WSL–M firms. We consider that transactions between M-WSL sellers and MFG buyers (M-WSL&MFG transactions) and transactions between MFG sellers and WSL-M buyers (MFG&WSL-M transactions) as transactions for intermediate MFG goods. We include these transaction links in our study in addition to MFG&MFG transaction links.

[9] A further investigation involves "homophily," i.e., the tendency that similar type of agents are more prone to maintain a relationship. WSL's share is smaller in population but more likely to transact with MFG firms. WSLs therefore seem to serve as intermediaries in transaction networks.

As shown in Table 1, of seller-buyer transaction links in TSR-TD, included in our study for intermediate MFG good transaction networks are the total of 785,261 transaction links, which are composed of the above three types: 356,130 MFG&MFG transaction links, 254,390 M-WSL&MFG transaction links, and 174,741 MFG&WSL-M transaction links.[10] Such transaction-link information can be combined to identify 2nd tier and 3rd tier transaction partners. In Table 1, we also show the number of MFG and WSL firms that engage in each type of transaction. Note that many firms engage in more than one out of the above types of transaction.

Table 2 shows the total number of MFG and WSL (M-WSL or WSL-M) firms behind transaction links included in our study, which are 110,872 MFG firms and 37,262 WSL firms. These are, respectively, 43% and 21% of MFG and WSL firms in the Japanese firm population. Lower coverage for WSL firms might be a reflection of our sample design due to our focus on intermediate MFG transaction networks. As also shown in Table 2, the coverage of our sample is higher for larger firms. For firms with 20 employees or more, our sample covers 84% of MFG firm population, and, for WSL, 51%.

Table 2 also shows that, in our sample, MFG firms on average have more employment than WSL firms. This tendency is consistent with the Japanese population data as well as US and Italian data (Bernard et al., 2010, 2011). In terms of sales, however, Table 2 shows that WSL firms are larger than MFG firms on average. While sales information is not publicly available for the entire Japanese firm population, for firms with 50 or more employees and capital of 30 million yen or more, the Basic Survey of Japanese Business Structure and Activities (MITI) shows that, as compared to MFG firms, WSL firms are on average larger in terms of sales but again smaller in terms of the number of employees. Overall, our sample seems to reflect the characteristics of Japanese firm population in terms of a size relationship between WSL and MFG firms.

3. Basic statistics from transaction-link data

3.1. Number of transaction partners

Here we present basic aspects of transaction networks for MFG intermediate goods using TSR-TD. Focusing on essential elements of transaction networks, first, we summarize statistics on the number of transaction partners per firm, which is often called "degree" in

[10] Our data show that many WSL firms distribute MFG final goods to retailers. Studying this role is, however, beyond the scope of this paper.

network literature. We compare such statistics between WSL and MFG firms. Helping firms to reach more buyers and/or more sellers is considered one of the main roles of WSL firms. However, a similar role might also be played by MFG firms in transaction networks.

We make comparisons between WSL and MFG firms in each of the following two samples; Sample 1: sample of transaction links with MFG sellers (i.e. MFG&MFG and MFG&WSL-M transaction links) and Sample 2: sample of transaction links with MFG buyers (i.e. MFG&MFG and M-WSL&MFG transaction links). Figure 1 shows sample design. Focusing on direct transaction links, first, using Sample 1, we compare the number of MFG sellers per MFG buyer with that per WSL-M buyer. Using Sample 2, we compare the number of MFG buyers per MFG seller with that per M-WSL seller. We use MFG&MFG transactions as a base for a comparison and include them in both Samples 1 and 2.

As Table 3 shows, based on Sample 1, on average, a M-WSL firm sells to more MFG firms than a MFG seller does, which is consistent with the typical view of WSL firms as distributors. Interestingly, however, based on Sample 2, we see that, on average, a WSL-M firm buys from almost the same number of MFG firms as an average MFG buyer.

In Figure 2, we show cumulative density functions for the number of MFG buyers (sellers) per firm.[11] The figures show that the numbers of MFG partners are highly skewed toward small numbers showing that transaction links are concentrated in a small share of MFG firms. Our data seem to share a similar tendency found in many other studies in network literature.[12] To our surprise, however, comparing MFG and WSL firms, the distribution is quite similar. For both MFG and WSL firms, firms with 1 to 3 MFG partners (sellers/buyers) represent about 70%, and 10 MFG partners (sellers/buyers) about 90%, whereas there are some MFG and WSL firms with over 1000 MFG partners (sellers/buyers).[13]

Once the number of MFG partners is divided by employment, however, the skew disappears, as shown in Figure 3. The same results are obtained when we divide the number of partners by sales. Here, we can see that, given firm size, WSL firms have more MFG partners than MFG firms have – consistent with a typical view. It seems important to take into account firm heterogeneity in examining per-firm numbers of transaction partners.

Figure 4 shows a correlation between the numbers of MFG buyers and MFG sellers per firm. Focusing on the firms with many partners, we find that the relation between the number

[11] The number of buyers and sellers are taken log.
[12] See Jackson (2008) for survey.
[13] Only the firms with at least one manufacturer buyer (seller) are included in the figure.

of MFG seller partners and MFG buyer partners per firm is much tighter for WSL firms than that for MFG firms. A WSL firm that buys from many MFG firms sells to many MFG firms, but an MFG firm that buys from many MFG firms does not necessarily sell to many MFG firms. Unlike WSL firms shifting the same goods from one firm to another, MFG firms produce goods using inputs they procure. It is possible that the nature of such goods as well as the firm's place in the supply chain hierarchy causes uneven number of sellers and buyers.

3.2. Characteristics of MFG firms connected directly vs those connected through WSL firms

Here we summarize what kind of MFG firms are connected by WSL firms, by comparing characteristics of MFG firms that are connected directly and those connected indirectly through WSL firms. Of transaction links included in our study, MFG&MFG transaction links connect MFG firms directly, and MFG&WSL-M and M-WSL&MFG transaction links connect MFG firms indirectly through WSL firms. We compare characteristics of MFG sellers (buyers) in MFG&MFG transaction links with MFG sellers (buyers) in MFG&WSL-M (M-WSL&MFG) transaction links. Note that, as shown above, larger firms have more transaction links. Thus, such firms naturally have more weight in the summary of firm characteristics based on transaction-link data. In a sense, here we describe an average transaction link for an intermediate MFG good transaction in terms of characteristics of both buyer- and seller-side MFG firms and compare it between a case in which MFG buyers and MFG sellers are connected directly and a case in which they are connected indirectly through WSL firms.

In making the comparisons, we focus on firm size in terms of sales, spatial distance between transaction partners, as well as firm location. Regarding a firm location, we describe it by MFG density in an area around each firm. It is possible that high MFG density fosters direct transactions between MFG firms, while it might also provide an opportunity for WSL firms to readily serve MFG firms and might foster the use of WSL firms. Using data from the Japanese Establishment and Enterprise Census, which provide data at municipal-area (shi-ku-cho-son) level, we first identify all municipal areas within 60 km of a given municipal area and consider them as a geographic unit. We then calculate the density of MFG establishments within the unit for each municipal area.

Table 4 shows the summary of MFG buyer and seller characteristics that are connected directly and those connected indirectly through WSL firms. The table shows that MFG sellers involved in indirect (MFG&WSL-M) transactions are, on average, larger and located in more

MFG dense areas than MFG sellers in direct (MFG&MFG) transactions. In contrast, MFG buyers involved in indirect (M-WSL&MFG) transactions are smaller and located in less MFG dense areas than MFG buyers involved in direct (MFG&MFG) transactions. Similar tendencies are found when we limit our sample to the transactions for which both buyers and sellers are main partners to each other. Note also that, for direct transactions between MFG firms, MFG sellers tends to be smaller and are located in areas with lower MFG density than MFG buyers. For intermediate MFG good transactions that are made indirectly through WSL firms, however, such tendency on MFG firm characteristics is reversed. We found that the same tendencies regarding firm size and location persist even when we remove industry specific effects on each firm characteristics.[14]

3.3. Transaction distance

We also compare spatial distance between MFG firms that are connected by direct transactions and distance between MFG firms connected through WSL firms. For MFG firms connected by direct transaction link, we take the average distance (in log) of all MFG&MFG transactions, which is 3.88 and is equivalent of 48 km as shown in Table 4. For MFG firms connected through WSL firms, we calculate distance separately for those connected by MFG&WSL-M transaction links and those connected by M-WSL&MFG transaction links.

In particular, for MFG&WSL-M transactions, for each MFG seller, we first identify the locations of all the 2nd tier MFG buyers that purchase from the MFG seller's 1st tier WSL buyer (WSL-M firm). We then calculate the centroid of the 2nd tier MFG buyer locations for each WSL-M firm and calculate the distance between the centroid and the MFG seller. We then take the average of such distance over all MFG sellers associated with MFG&WSL-M transactions. Analogously, for M-WSL&MFG transactions, we calculate distance between each MFG buyer and the centroid of the 2nd tier MFG sellers and calculate the average distance. As Table 4 shows, the average distance (in log) for both cases is about 5, which is about 150 km. MFG firms connected indirectly through WSL firms seem located much farther to each other than MFG firms connected directly. It does seem that distance between MFG firms matters in whether they are connected directly or indirectly.

[14] To check whether the above tendency is common across MFG sub-industries and not reflecting particular industry characteristics, for MFG sellers and MFG buyers, we respectively perform a regression of each characteristic on a dummy, indicating transactions through WSL firms as well as 3-digit MFG industry dummies. We also take into account whether a transaction partner is a main partner, by including a dummy indicating transactions with a main seller (to its buyer) and transactions with a main buyer (to its seller). The above tendency remains essentially the same.

The question arises then as to how distances between an MFG and a WSL firms are distributed compared with distances between MFG firms connected directly. Figure 5 shows the distribution of distances between firms that are linked by MFG&MFG, M–WSL&MFG, and MFG&WSL–M transactions. Interestingly, as compared to MFG&MFG transaction links, the transaction distance between MFG and WSL firms tends to be longer than that of MFG&MFG transaction links when MFG firms are sellers and shorter when MFG firms are buyers. As compared to MFG firms, WSL firms seem to be located closer to their MFG buyer partners but farther from their MFG seller partners. The same tendency is also found at firm-level data as shown in Figure 6.

4. Regression analyses on which MFG firms are connected by WSL firms in transaction networks

4.1. Evidence from transaction-link data

To examine how each characteristic of MFG buyers and MFG sellers is associated with whether the MFG firms are connected directly or indirectly through WSL firms ceteris paribus, we perform linear probability analyses. We first characterise a transaction link by attributes of MFG firms that are connected directly or indirectly by the link. For an MFG&MFG transaction link, an MFG buyer and an MFG seller are connected directly, and we use their characteristics to describe the transaction link. For an MFG&WSL-M transaction link, an MFG seller is not directly connected to an MFG buyer but has 2nd tier MFG buyers that purchase through WSL firms. We use average characteristics of such 2nd tier MFG buyers in addition to MFG seller characteristics to describe MFG firms connected by the MFG&WSL-M transaction link. Analogously, for an M-WSL&MFG transaction link, we use characteristics of an MFG buyer and average characteristics of its 2nd tier MFG sellers to characterise the transaction link.

We then perform linear probability analyses separately for Samples 1 and 2. With Sample 1 (sample of transaction links with MFG sellers), we examine how the characteristics of MFG firms differ depending on whether they are connected directly by a MFG&MFG transaction link or indirectly by a MFG&WSL-M transaction link. With Sample 1 (sample of transaction links with MFG buyers), we examine how the characteristics of MFG firms differ depending on whether they are connected directly by a MFG&MFG transaction link or indirectly by M-WSL&MFG transaction link. In Figure 1, the firms included in the analyses to characterise each transaction link are indicated as shaded.

A specification we use is written in (1), in which $DWSL_{sb}$ is a dummy indicating that a transaction is with a WSL firm and not an MFG&MFG transaction, $\mathbf{X}_s^{MFG}$ is a vector of characteristics of MFG sellers, and $\mathbf{X}_b^{MFG}$ is a vector of characteristics for MFG buyers. Again, for Sample 1, $\mathbf{X}_b^{MFG}$ is a vector of average characteristics of 2nd tier MFG buyers of an MFG seller, and for Sample 2, $\mathbf{X}_b^{MFG}$ is a vector of an average characteristics of 2nd tier MFG sellers of an MFG buyer.

$$DWSL_{sb} = f(\mathbf{X}_s^{MFG}, \mathbf{X}_b^{MFG}, \mathbf{Z}_{sb}) + u_{sb} \quad (1)$$

With Sample 1, we perform linear probability analyses with fixed effects of 3-digit JSIC (Japan Standard Industry Classification) industries for MFG sellers. With Sample 2, we perform analyses with 3-digit JSIC fixed effects for MFG buyers.[15] The fixed effects help to control kinds of goods transacted in each transaction especially for Sample 1 in which MFG seller industries are controlled for. We also control for whether a seller and/or buyer is a main partner to its transaction partner. Table 5 shows the results.

Results

For both Samples 1 and 2, as shown in Table 5, we find that the likelihood that an MFG intermediate good transaction is through WSL firms increases as buyer-side MFG firms are smaller and as seller-side MFG firms are larger. In addition, such a likelihood increases as buyer-side MFG firms are located in less MFG dense areas and as seller-side MFG firms are located in more MFG dense areas. The asymmetry in the effects of characteristics between MFG buyers and MFG sellers is interesting. In the downstream-upstream hierarchy of direct transactions between MFG firms, it seems that downstream MFG firms tend large and that upstream firms tend small. At the same time, downstream MFG firms tend to be in MFG dense areas, and upstream MFG firms tend to be in MFG sparse areas. For other combinations of MFG buyers and MFG sellers, it is possible that net benefits from relying on WSL firms exceed that of direct transactions.

Here, we discuss how these results can be explained in terms of costs involved in transactions. In particular, we focus on search and monitoring costs, although there are many other possible explanations. For MFG buyers, the nature and the quality of inputs directly influence their products, and thus, searching "right" and "good" sellers as well as monitoring

[15] 3-digit JSIC is as fine as 3-digit SIC or 4-digit NAICS. For more detail, see http://www.stat.go.jp/english/index/seido/sangyo/

sellers for quality control would be crucial. For MFG sellers, securing more buyers for their products would be important. When MFG firms produce less general goods, searching "matched" buyers would be crucial. In addition, if the production requires long-term contracts (for, say, producing specific goods), for sellers to monitor financial status of the buyers would also be important. Our results seem to suggest the possibility that these search and monitoring costs affect MFG sellers and MFG buyers differently in terms of whether or not they transact through WSL firms.

Based on the above, first, let us explain our results on firm size. If there are fixed costs in in searching and monitoring, larger MFG firms should have more advantages in searching and monitoring themselves and thus would transact directly with other MFG firms, ceteris paribus. This is consistent with our result for MFG buyers but inconsistent for MFG sellers.

Regarding MFG buyers, small downstream MFG firms might not be able to search and monitor efficiently in-house and thus might rely on WSL firms for procuring inputs. Specializing in such roles and servicing many MFG firms, a WSL firm might have more scale economies in searching and as compared to a small MFG buyer. Note, however, that, assuming that scale economies in a WSL firm as a buyer come from pooling the needs of MFG buyers, WSL firms would not be able to satisfy a level of specificity that each MFG buyer would desire otherwise. By relying on WSL firms, small MFG buyers would give up a certain level of input specificity but achieve more cost reduction benefits coming from efficient searching and monitoring by WSL firms. For large MFG buyers, because they have a certain level of scale economies in searching and monitoring themselves, the net benefits from procuring specific inputs by direct transactions would be greater than that of using more general inputs supplied by WSL firms.

Regarding MFG sellers, we find that larger MFG sellers tend to rely more on WSL firms for distributing their goods, which is inconsistent with the existence of fixed costs in searching and monitoring. Even if the effects of fixed costs exist, they seem to be offset by the effects of other factors. As we showed before, a larger MFG firm has more buyer partners. Supplying to more firms, it is possible that products of larger MFG firms are more general, even within a 3-digit JSIC industry category. An MFG firm producing a more general good would be less likely to require a long-term relationship with a specific MFG buyer. Because MFG firms producing general goods require no specific investment and have many potential buyers, such MFG sellers would not have to worry about financial status of a specific buyer and thus would not need monitoring. In this case, the MFG seller only has to secure more

buyers. Given this, for distribution of general goods, a WSL firm might have more advantage than a MFG firm, even when the MFG firm is large, and thus large MFG sellers might rely on WSL firms.

On the other hand, small MFG sellers might be producing more specific goods (and that is why they are small). It is possible that distribution of specific goods would not be more efficient even performed by WSL firms. Note, however, having a few buyer, for small MFG sellers to secure buyers with sound financial status would be important, and they might be able to monitor efficiently only when a buyer is larger, because for larger firms, more hard information is available. In fact, larger MFG buyers tend to transact directly to other MFG sellers. Direct transactions between small MFG buyers would be difficult.

In sum, larger MFG firms produce more general goods and rely more on WSL firms for distribution. For procuring inputs, however, larger MFG firms tend to contract with suppliers themselves. Given that larger MFG firms have certain scale economies in monitoring and searching, their benefits of direct transaction and procuring specific inputs would more likely exceed those of relying on WSL firms. Small MFG firms produce more specific goods, and thus long-term contracts would be required to sell their goods. For specific goods, WSL firms are not necessarily be able to take advantage of each of their scale economies for searching and monitoring, and thus small MFG suppliers might just make contracts directly with large MFG buyers, for which at least hard information on financial status is available. On the other hand, small MFG buyers might not be able to procure specific inputs themselves and would decide to use more general inputs relying on WSL firms.

Now let us explain the results on MFG locations. Based on the results in Table 5, among MFG buyers, those who are in more MFG dense areas seem to rely less on WSL firms for procurement. On the other hand, among MFG sellers, those who are located in more MFG dense areas seem to rely more on WSL firms for distribution. For MFG buyers, it is possible that greater MFG density at their locality reduces costs to search and monitor MFG sellers themselves. Surrounded by many potential MFG partners in a close proximity, it would be easier to find MFG sellers producing specific goods and to monitor such MFG sellers themselves, which would allow MFG buyers in more MFG dense areas to transact directly with MFG sellers without relying on WSL firms. For MFG sellers, greater MFG density could also reduce their costs in monitoring the financial status of MFG buyers and would reduce reliance on WSL firms. Such effects, however, seem to be offset by other effects. It is possible that, even after controlling for firm size, MFG firms in less and more MFG dense areas are different

in terms of other attributes. There are various possible explanations for this. For example, it is possible that MFG firms in MFG dense areas are more productive and can produce goods of higher quality and use WSL firms to sell their products in much geographically further areas. Including such aspects in the analysis is our future goal.

4.2. Evidence from firm data

The above analyses based on TSR-TD provide us with a contrasting view of characteristics of MFG firms associated with intermediate MFG good transactions with and without reliance on WSL firms. As we showed in Section 3, however, because larger MFG firms have more transaction partners, it is possible that our results in Section 4.1 are affected more by tendencies among larger MFG firms even after controlling for firm size. Thus, in this section, we perform firm-level analyses to test how an MFG firm's characteristics are associated with the extent to which the MFG firm relies on WSL firms.

Using Sample 1, we calculate, for each MFG seller, the share of transaction links with WSL (M-WSL&MFG transactions) out of all of the links for intermediate MFG good distribution and view it as the extent to which the MFG seller relies on WSL firms for its MFG input distributions. We then perform firm-level analyses, regressing MFG sellers' WSL reliance on the MFG sellers' characteristics. Analogously, using Sample 2, we calculate, for each MFG buyer, the share of transaction links with WSL (MFG&WSL-M transactions) out of all of the links for intermediate MFG good procurement. We use it as the extent to which the MFG buyer relies on WSL firms for its MFG input procurement and regress the shares on MFG buyer characteristics.

Table 6 presents the results. The results are qualitatively the same as those based on the transaction-level data and indicate again that an MFG buyer relies more on WSL firms in procuring inputs if it is smaller and is located in less MFG dense areas. It also indicates that an MFG seller relies more on WSL firms in distributing their intermediate goods if it is larger and is located in more MFG dense areas.

5. Regression analysis on the distance to 1st tier transaction partners

In Section 4, we learn that clear differences exist between MFG firms that are connected directly and those connected through WSL firms and such tendencies are different between MFG buyers and MFG sellers. We also know from Section 3 that MFG firms connected

through WSL firms are more geographically distant from those connected directly. It seems that WSL firms help MFG firms to overcome long transaction distances. Then, how do WSL firms help MFG firms overcome such geographical friction? Here we shed light on distances between MFG and WSL firms in examining whether WSL firm location is an important factor that partly allows WSL firms to intermediate between MFG firms that are geographically distant.

To do so, using transaction-level data, we examine how a distance between an MFG firm and its 1st tier partner is associated with their characteristics and how the relationship varies depending on whether the 1st tier partner is an MFG or a WSL firm.

As a possible determinant for transaction distances, we include firm size. It is often argued in urban economic literature that shipping involves fixed costs, which suggests that large shipping volume is required to justify a long-distance shipping. Recent studies in the literature of international trade also present evidence that supports a view that large trade volume is required to overcome fixed costs associated with international trade and argue that trade is unlikely when both an importer and exporter are small. As such, we also include an interaction term between seller size and buyer size.

Another variable we consider an important determinant for a transaction distance is the MFG density of an area around an MFG firm. For MFG&MFG transactions, the greater MFG density would make it easier for both MFG buyers and MFG sellers to find matched or ideal MFG partners in their locality, which would result in shorter transaction distances.

In addition to these variables, we include a dummy (DWSL) indicating transaction links between an MFG and a WSL firms (vs MFG&MFG transaction links). As we saw in Section 3, relative to MFG firms in MFG&MFG transaction links, WSL firms seem to be located closer to their MFG buyer partners than to their MFG seller partners. The coefficient of DWSL tells whether such tendency remains after controlling for the effects of other variables. We also include interaction terms between DWSL and other variables (firm size and MFG density) to see how the distance of transactions between an MFG and a WSL is determined differently from that of MFG&MFG transactions.

Results

Table 7 shows the results of regressions for both Samples 1 and 2. We again control for industry (3-digit JSIC) fixed effects as well as main and non-main status of buyers and sellers.

Let us first focus on the results based on a specification without the interaction terms with DWSL (i.e. Columns (1) and (3)). Regarding firm size, both seller size and buyer size obtain positive and significant coefficients, and the interaction term obtains a negative and significant coefficient. This is the case in both samples of transaction links and thus regardless of industries (MFG, WSL) of buyers and sellers. It seems that larger firm size allows a longer distance transaction, but not both seller and buyer have to be large. To the extent that a long distance transaction could involve fixed costs, our result is consistent with the view in the previous studies that at least a buyer or a seller has to be large so that transaction volume can become large enough to overcome fixed transaction costs. Transactions between small firms tend to remain local. [16]

Turning to MFG density, based on Sample 1, we find that MFG density at the locality of an MFG seller is negatively associated with a transaction distance and, based on Sample 2, that MFG density at the locality of an MFG buyer is also negatively associated with a transaction distance. The greater density of MFG firms in an area seem to allow the MFG firms to find a matched partner in close proximity whether the partner is an MFG or a WSL firm.

The coefficient of DWSL is positive and significant in Sample 1 and is negative and significant in Sample 2. As compared to the case in which a transaction is made between MFG firms (MFG&MFG transaction), the transaction distance is longer when an MFG firm sells its goods to a WSL buyer and is shorter when an MFG buyer procures inputs from a WSL seller. The tendency we present in Section 3.3 is found even after controlling for effects of other variables. If WSL firms help MFG firms overcome long distances for transactions and if the WSL location is one of the factors contributing to it, it seems, somehow, that WSL firms overcome long distances by locating themselves closer to their MFG buyers rather than MFG sellers. By locating themselves closer to MFG buyers, WSL firms could learn the needs of MFG buyers and could more efficiently serve them. A geographical proximity to MFG buyers would also help WSL firms to obtain more knowledge on the MFG buyers' financial status. It is possible that such information that WSL firms acquire encourages MFG sellers to justify long distance transactions.

[16] Note that the TSR-TD covers between-firm, not between-establishment transactions. Thus, a buyer-seller link is a link between headquarters and does not necessarily coincide with the exact locations to and from which goods are shipped. This is not the case for firms with only one establishment. Thus, we perform the same analysis, limiting our sample to transactions with MFG sellers with only one establishment for Sample 1, and those with MFG buyers with only one establishment for Sample 2. The results remain qualitatively the same.

Next, let us interpret the results in columns (2) and (4). The negative coefficient of an interaction term between DWSL and MFG density suggests that the negative effects of MFG density on transaction distance is larger for transaction links between an MFG and a WSL firm than those between MFG firms. It seems that MFG firms in more MFG dense areas have both WSL and MFG partners geographically close by as compared to MFG firms in less MFG dense area, but the density effect is greater for finding WSL partners than MFG partners. It is possible that WSL firms have less restriction on their locations as compared to MFG firms and can locate themselves more closely to their MFG partners to better serve them. As we show in Appendix 1, WSL firms seem more footloose, locating themselves disproportionately more in areas with high MFG density.

Finally, based on Sample 1, the coefficients of interaction terms between DWSL and both seller and buyer sizes are negative and significant, and based on Sample 2, the coefficient of interaction terms between DWSL and both seller and buyer sizes are positive and significant. In both Samples 1 and 2, larger buyer and seller sizes seem to offset the effects of DWSL. For transaction links in Sample 1, while transaction distance is longer when an MFG seller's partner is a WSL buyer rather than an MFG buyer, such difference is diminished when either the seller or the buyer (or both) is larger. For transaction links in Sample 2, while the transaction distance is shorter when an MFG buyer's partner is a WSL seller rather than an MFG seller, again, such difference is diminished when either the buyer or the seller (or both) is larger. Looking at information on sub-industries provided by the TSR data, when firms are larger, they are more likely to engage in more diverse activities. As firms perform both MFG and WSL activities, our distinction between MFG and WSL firms based on firms' primary industry may become less important, which partly explain the results.

6. Conclusion

Taking advantage of the unique transaction data that allow us to observe buyer–seller links and both of their characteristics, we compare characteristics of MFG buyers and sellers that are connected through WSL firms and those transacting directly.

We find a striking asymmetry between MFG buyer and MFG seller characteristics in their tendencies in relying on WSL firms for intermediate MFG good transactions. For distribution, we find that larger MFG sellers are more likely to rely on WSL firms, and that, for procurement, smaller MFG buyers are more likely to rely on WSL firms. We also

characterize an MFG firm's location by the area's MFG density and find that among MFG firms with the same size and industry, MFG buyers in less MFG dense areas and MFG sellers in more MFG dense areas are more likely to rely on WSL firms. Our findings indicate an importance in distinguishing buyers and sellers in understanding why they rely on WSL firms respectively for procurement and distribution. In particular, our findings seem to suggest that MFG buyers that are smaller and/or are in less MFG dense areas cannot efficiently find a matched MFG partner and/or monitor their MFG suppliers themselves and thus tend to rely on WSL firms, ceteris paribus. Purchasing inputs from WSL firms, small MFG buyers might compromise the degree of input specificity. It is also possible that procuring from many small MFG buyers, WSL firms reduce demand shocks from individual MFG buyers.[17]

Our findings also seem to suggest that MFG sellers that are larger and/or in more MFG dense areas rely on WSL firms for procuring inputs. This contradicts with the view that larger size and higher MFG density would also make MFG sellers efficient in finding MFG partners themselves. Assuming that goods transacted through WSL firms are more general than goods transacted directly between MFG firms, it is possible that the size of MFG sellers in our data might be positively correlated with the extent to which their goods are general. It is also possible that the quality of MFG goods produced by MFG firms that are larger and/or in more MFG dense areas are higher. Such goods could have a wider demand and require WSL firms to be distributed.

Examining transaction distance, we also find that WSL firms locate themselves closer to their MFG buyers than to their MFG sellers, indicating a possibility that the proximity to MFG buyers rather than MFG sellers helps WSL firms to intermediate between MFG firms more efficiently. It is possible that being located closer to MFG buyers, WSL firms collect detail information on kinds and schedules of input demand, which would be valuable for MFG sellers supplying inputs. Our analyses on distance also supports the view that either a buyer or a seller (or both) has to be large for a long-distance transaction, because it requires a certain trade volume to overcome fixed costs. This is consistent with findings in the literature of international trade.

[17] In particular, Bernard et al. (2013) show that wholesaler exporters have more advantages in maintaining exporting volume in response to exchange rate volatilities by adjusting their export product mix.

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Table 1 Transaction links included in our analyses

	N of transactions	Seller		Buyers	
MFG-toMFG transaction	356130	92968	MFG firms	83460	MFG firms
M-WSL&MFG transactions	254390	37262	M-WSL firms	84901	MFG firms
MFG&WSL-M transactions	174741	52760	MFG firms	37267	WSL-M firms
Total	785261				

Table 2 Number of Firms included in our Analyses

		Our sample		Japanese population*		Our sample share in populatic	
		MFG	WSL	MFG	WSL	MFG	WSL
N of firms		110,872	37,262	258,648	175,057	43%	21%
Employment	Mean	61.4	41.4	34.2	18		
	Median	15	11				
Sales (thousand yen)	Mean	3217	6475				
	Median	300	660				
Employment category	0~4	14,949	7,544	107,400	94,434	14%	8%
	5~9	21,610	8,750	52,335	33,203	41%	26%
	10~19	25,456	7,833	40,604	21,459	63%	37%
	20~29	13,670	3,581	17,531	8,212	78%	44%
	30~49	13,395	3,548	15,554	7,056	86%	50%
	50~99	11,273	3,129	12,694	5,692	89%	55%
	100~299	7,541	2,140	9,013	3,740	84%	57%
	300~999	2,241	620	2,666	1,047	84%	59%
	1000~1999	430	78	472	137	91%	57%
	2000~4999	216	27	272	63	79%	43%
	5000~	91	12	107	14	85%	86%

* Source: The 2006 Establishment and Enterprise Census (Ministry of Internal Affairs and Communications)

Table 3 Summary of our sample

Transactions with MFG sellers: Sample 1				
	N of buyers	N of transactions		Avg N of MFG sellers per buyer firm
MFG buyers	83,460	356,130	(MFG&MFG transactions)	4.27
WSL-M buyers	37,262	174,741	(MFG&WSL-M transactions)	4.69
Total		530,871		

Transactions with MFG buyers: Sample 2				
Seller firm	N of sellers	N of transactions		Avg N of MFG buyers per seller firm
MFG	92,968	356,130	(MFG&MFG transactions)	3.83
M-WSL	37,262	254,390	(M-WSL&MFG transactions)	6.83
Total		610,520		

Table 4 Mean characteristics of MFG buyers and MFG sellers

		Direct transaction		Indirect transaction	
		MFG&MFG		MFG&WSL-M	M-WSL&MFG
	N of transactions	35613	35613	174741	254390
		MFG Seller	MFG Buyer	MFG Seller	MFG Buyer
	Firm characteristics				
Size	Ln employment	4.01	5.2	4.66	4.3
	Ln sales	14.2	15.7	15.2	14.6
Density	dens60k	7.39	8	8.03	6.6
	dens30k	16.8	19.2	20	15.2
Distance				A distance between	A distance between
				a MFG seller and	a MFG buyer and
				2nd tier MFG buyers	2nd tier MFG sellers
	Ln Distance	3.88	3.88	5.02	5

Table 5 Transaction-link level regression on wholesaler use

	Sample 1	Sample 2
	MFG&MFG VS MFG&WSL-M	MFG&MFG VS M-WSL&MFG
	D=1 if a transaction is	D=1 if a transaction is
Dependent Variable	MFG&WSL-M	M-WSL&MFG
ln Sales of MFG seller+	0.0267***	0.0332***
	(79.39)	(103.1)
MFG Density of an area	0.00365***	0.00640***
of a MFG seller+	(27.49)	(46.63)
ln Sales of MFG buyer++	-0.0143***	-0.00686***
	(-51.15)	(-21.65)
MFG Density of an area	-0.00406***	-0.00544***
of a MFG buyer++	(-31.35)	(-40.76)
Constant	0.123***	0.0356***
	(19.80)	(5.542)
Main-Notmain status	Yes	Yes
Industry dummies	Yes	Yes
Observations	530,871	610,520
R-squared	0.115	0.116
t-statistics in parentheses		
*** p<0.01, ** p<0.05, * p<0.1		

+: For a M-WSL&MFG transaction, we consider MFG sellers of the M-WSL firm as indirect sellers of the MFG buyer and use their average characteristics
++: For a MFG&WSL-M transaction, we consider MFG buyers of the WSL-M firm as indirect buyers of the MFG seller and use their average characteristics

Table 6 Firm level regression on wholesaler use

Table 6 Firm level regression on wholesaler use		
WSL shares of partners (share of indirect transactions)		
Sample	MFG buyers	MFG sellers
Dependent variable	WSL share of sellers	WSL share of buyers
ln Sales	-0.0262***	0.0210***
	(-27.57)	(21.94)
dens60k	-0.00393***	0.00174***
	(-11.62)	(3.831)
Constant	0.875***	0.0519***
	(65.68)	(4.089)
Industry fixed effects	Yes	Yes
Observations	93,054	110,872
R-squared	0.099	0.231
Robust t-statistics in parentheses		
*** p<0.01, ** p<0.05, * p<0.1		

Table 7 Regression on transaction distances between a MFG firm and its 1st tier partner

	Sample 1 Transactions with a MFG seller		Sample 2 Transactions with a MFG buyer	
	(1)	(2)	(3)	(4)
ln Sales of a seller	0.844***	0.830***	0.851***	0.837***
(seller: MFG for Sample 1, WSL for Sample 2)	(122.7)	(120.0)	(137.6)	(130.7)
ln Sales of a buyer	0.721***	0.712***	0.754***	0.736***
(buyer: WSL for Sample 1, MFG for Sample 2)	(114.3)	(113.3)	(122.7)	(119.2)
ln Sales of a seller X ln Sales of a buyer	-0.0428***	-0.0415***	-0.0443***	-0.0439***
	(-98.05)	(-94.94)	(-107.5)	(-105.7)
MFG Density of an area of a MFG firm	-0.0676***	-0.0598***	-0.0305***	-0.0106***
	(-114.4)	(-86.61)	(-54.23)	(-14.54)
DWSL=1 if a partner is a WSL firm	0.269***	1.372***	-0.410***	-0.965***
	(41.46)	(24.03)	(-73.86)	(-21.22)
DWLS X ln_Sales of a seller		-0.0178***		0.0257***
(seller: MFG for Sample 1, WSL for Sample 2)		(-6.783)		(12.16)
DWLS X ln_Sales of a buyer		-0.0413***		0.0353***
(buyer: WSL for Sample 1, MFG for Sample 2)		(-19.07)		(17.26)
DWLS X_MFG Density of an area of a MFG firm		-0.0255***		-0.0497***
		(-20.40)		(-45.65)
Constant	-8.421***	-8.452***	-9.157***	-8.881***
	(-82.40)	(-82.43)	(-96.72)	(-91.34)
Main-Notmain status	Yes	Yes	Yes	Yes
MFG 3-digit industry fixed effects	Yes	Yes	Yes	Yes
Observations	530,871	530,871	610,520	610,520
R-squared	0.119	0.121	0.110	0.113

Robust t-statistics in parentheses

*** p<0.01, ** p<0.05, * p<0.1

Figure 1: Sample design: MFG firms connected directly/indirectly by each type of transaction links

Sample 1: MFG seller sample

Type of direct transaction	Seller		MFG seller's 1st tier (direct) buyer		MFG seller's 2nd tier buyer
MFG&MFG transaction	MFG seller	⇒	MFG buyer		
MFG&WSL-M transaction	MFG seller	⇒	WSL firm	⇒	MFG buyers

Sample 2: MFG buyer sample

Type of direct transaction	Buyer		MFG buyer's 1st tier (direct) seller		MFG buyer's 2nd tier seller
MFG&MFG Transaction	MFG buyer	<=	MFG seller		
M-WSL&MFG Transaction	MFG buyer	<=	WSL firm	<=	MFG sellers

=>: a flow of intermediate goods

Figure 2: Distribution of N of buyers and N of sellers per firm

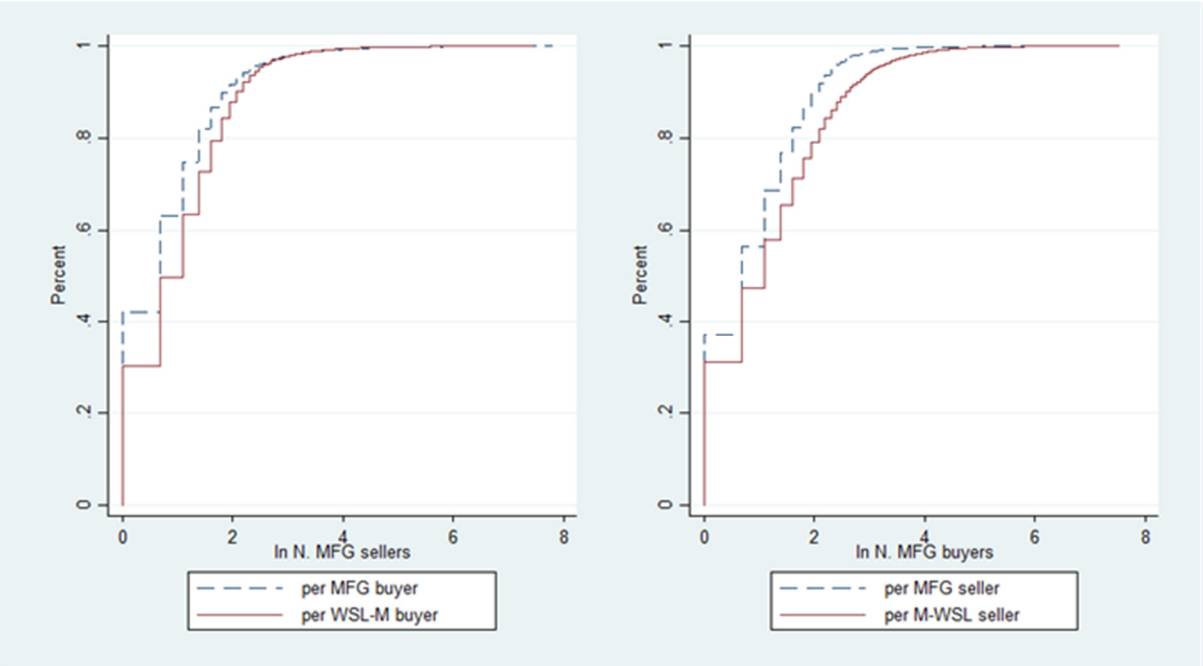


Figure 3: Distribution of N of buyers and N of sellers divided by employment

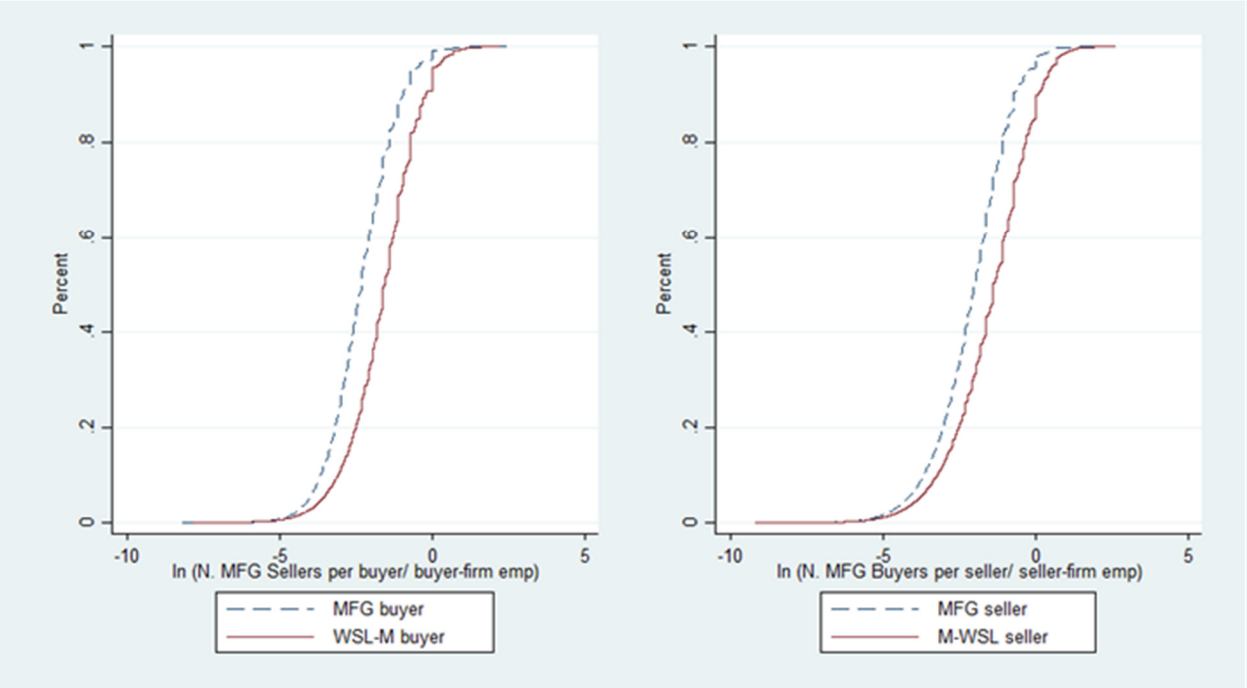


Figure 4: Correlation between N of buyers and N of sellers per firm

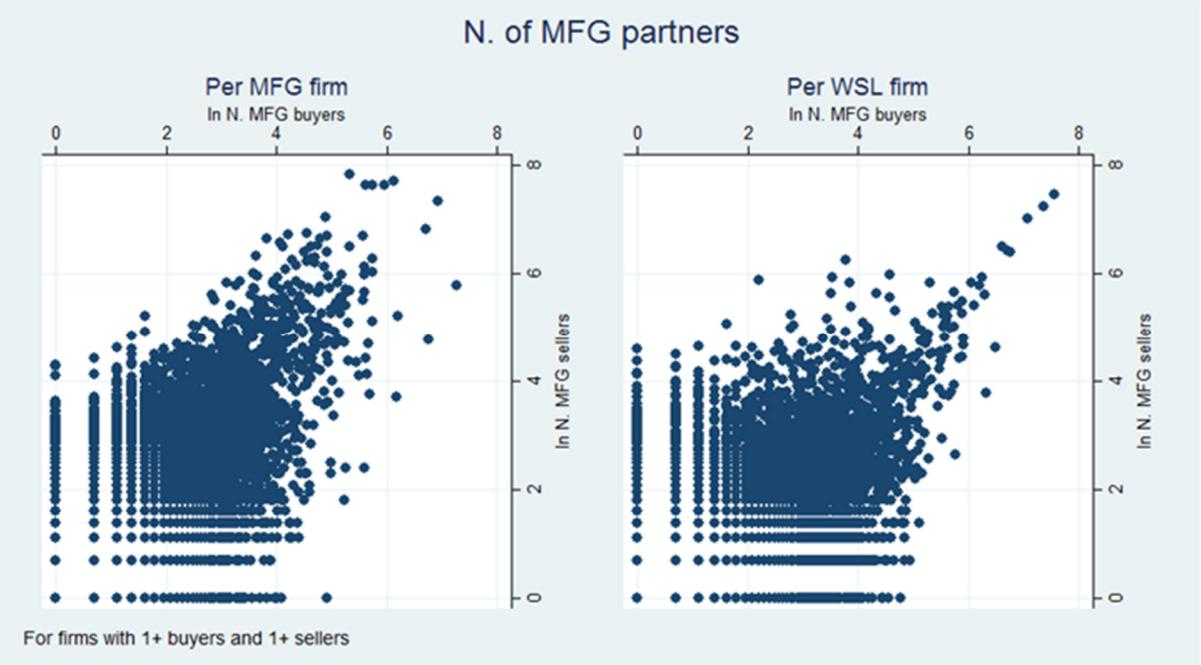


Figure 5: Distribution of transaction distance

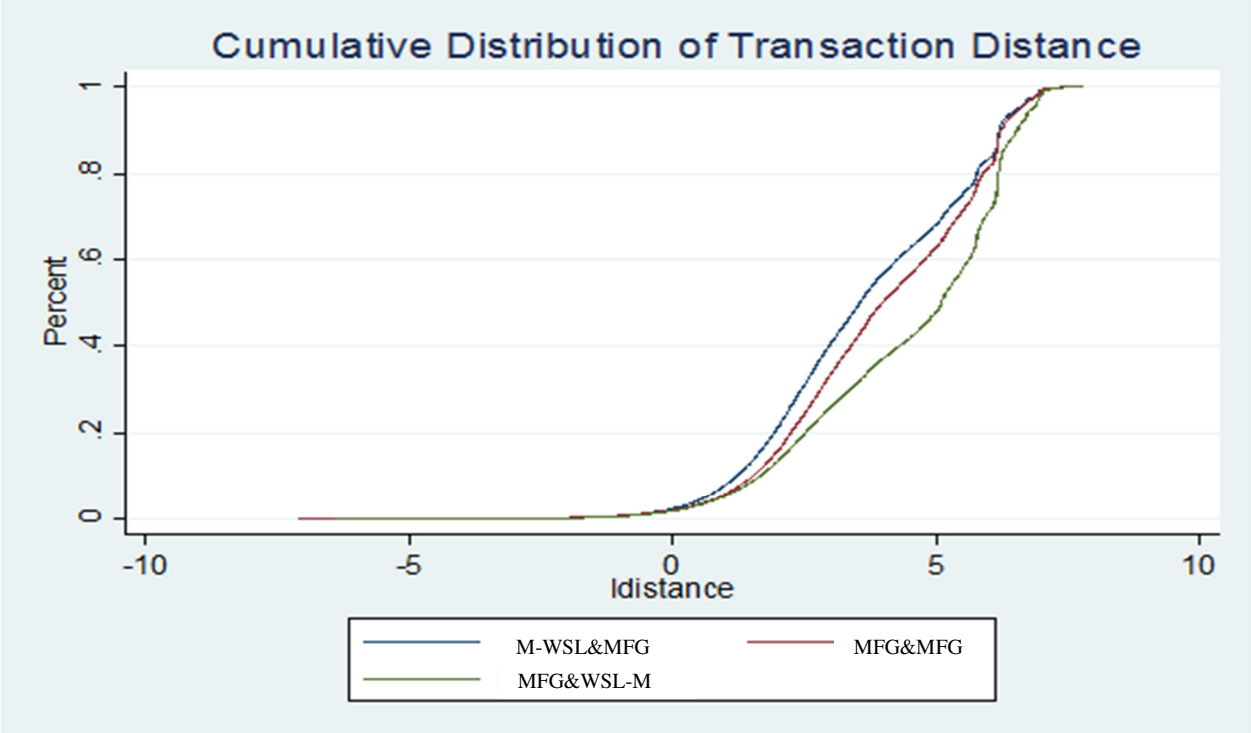
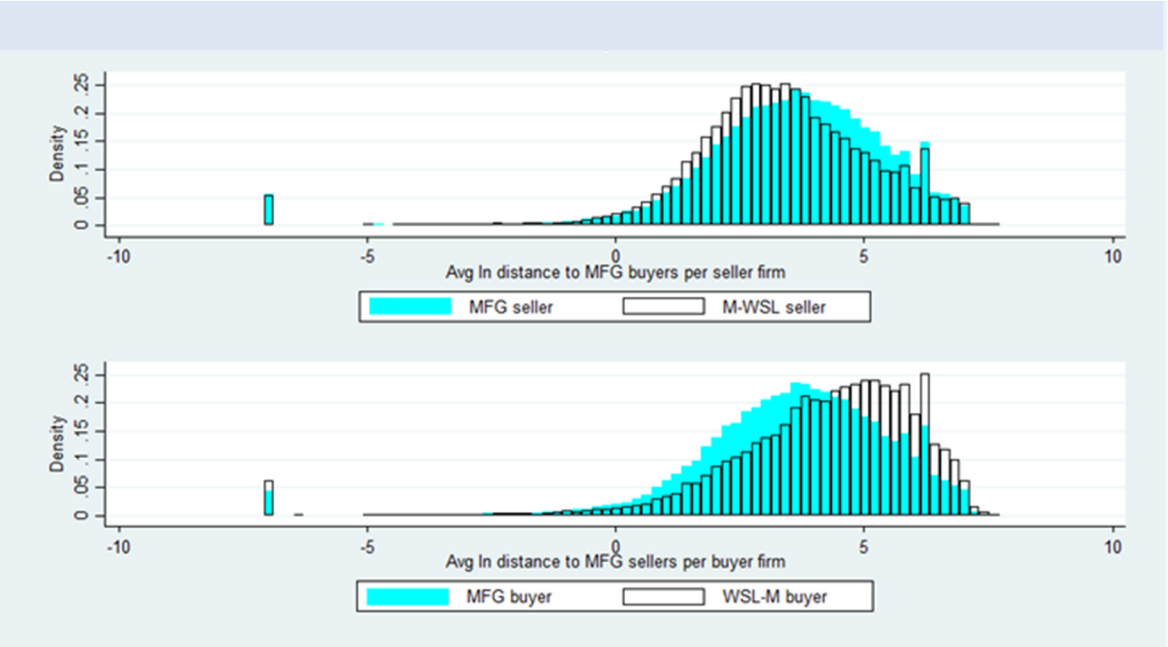


Figure 6: Distribution of transaction distance



(note: for transaction partners for which the same GIS info is matched, we assume the minimum distance in our sample)

Appendix 1

To show the location pattern of WSL firms in relation to MFG firms, here we use data from the Establishment and Enterprise Census, which contains the location of all establishments in Japan. First, we obtain the establishment count for each 60 km geographical mesh for each industry. We then calculate for each mesh a location quotient (*LQ*) for WSL establishments with respect to MFG establishments, which is defined as

$$LQ \equiv \frac{\left(\dfrac{\text{N of WSL establishments in a mesh}}{\text{Total N of WSL establishments in Japan}} \right)}{\left(\dfrac{\text{N of MFG establishments in a mesh}}{\text{Total N of MFG establishments in Japan}} \right)}.$$

The nominator of the *LQ* index is the mesh's share of WSL establishments in Japan, and the denominator is that of MFG establishments. Thus, in a mesh with *LQ*=1, WSL are located proportionately to MFG. In a mesh with *LQ*>1, WSL are concentrated disproportionately more than MFG. To see the distribution of WSL relative to that of MFG, the figure below plots the LQs against the MFG share in a mesh. The LQ for WSL is greater in areas with higher MFG density. It thus seems that WSL establishments are attracted to areas with high MFG density.