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ARTICLE

Team familiarity, task familiarity, and quality competition: Evidence from Japanese sake brewing

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Abstract
Using longitudinal data on teams and quality competition results, this study examines the impact of team and task familiarity on brewing excellence in the Japanese sake industry from 1956 to 2018. Sake production involves teamwork at every stage, but while some teams work together long term, others experience high turnover. The study highlights two factors: team familiarity, the collective experience of working together, and task familiarity, the individual experience of the task. High familiarity can strengthen team bonds and improve teamwork, but it can also limit the inflow of new knowledge and thus hinder innovation. This study uses data from national quality competitions and brewer lists, and considers the Great East Japan Earthquake of 2011 as an external shock to address endogeneity and estimate the causal relationship between familiarity and competition outcomes. The empirical results show that increases in both team and task familiarity are negatively associated with quality superiority.

Keywords: sake brewing; quality competition; team familiarity; task familiarity; novelty

JEL classifications: O31; D21; L66

I. Introduction

How do team familiarity and task familiarity influence sake brewing performance? This study aims to examine this question by scrutinizing teams in sake brewing and quality competition results from 1956 to 2018.

A significant amount of sake brewing is conducted in teams, which are formed only for the duration of a single project and are composed of members who may join or leave a team. Therefore, it is important for understanding organizational performance to examine not only individual-level and firm-level characteristics but also team-level characteristics for estimating performance. The brewing season is from late September or early October till March. How the sake brewing team is organized is explained in detail in the III section.

As team members work together over time, they become familiar with the task domain and each other (Katz, 1982). Team members develop a common knowledge base through which team interaction and the location of expert sources in the team can occur (Alavi and Leidner, 2001). Therefore, it is possible to suppose that team familiarity, which measures members' experience working together, plays an important role in determining team performance.

Previous studies on team familiarity have observed positive benefits on team performance in mining (Goodman and Leyden, 1991), flight simulation (Kanki and Foushee, 1989), problem-solving (Gruenfeld et al., 1996), software development (Espinosa et al., 2007; Huckman et al., 2009), and basketball (Grijalva et al., 2020; Sieweke and Zhao, 2015). As will be reviewed in detail in the following section, the previous literature has measured team productivity, such as efficiency and failure rate. Since team members learn with each other and develop shared knowledge and norms, it is reasonable to observe that such efficiency increases as team familiarity increases.

When team members repeatedly work with the same members, accumulate the same experiences, and develop the same norms of working, it means that they are bound together by strong ties with certain exclusivity. As a result, it is possible to assume that new information flow becomes limited, even though work efficiency increases (Granovetter, 1973; March, 1991). As team familiarity increases, the potential for innovation to be generated could be reduced. Therefore, directing its attention to the superiority of product quality, in which novelty is required, rather than team productivity, this study explores how team familiarity influences product innovation. This study also examines task familiarity, which is strongly related to team performance on novelty. Task familiarity has often been analyzed in previous studies on team familiarity. It has been pointed out that although task familiarity is one of the important factors that determine team performance, team familiarity is more important (Huckman and Staats, 2011; Huckman et al., 2009). However, as noted above, prior studies examining team familiarity have examined team productivity, not high levels of novelty. This point is also true for task familiars. A high level of task familiarity means that team members have a high level of expertise in the task. While this may lead to high productivity, it may also inhibit innovation through fixed work practices, psychologically fixed ideas on tasks, and a lack of influx of new knowledge.

By using longitudinal data on brewing team members, team formation, and quality competition results in the sake brewing industry in Japan from 1956 to 2018, this study examines how team familiarity and task familiarity influence quality superiority.

II. Previous literature and hypothesis

Sake has been analyzed from various perspectives, including its history (Kitagaki and Kitamoto, 2013), corporate survival (Sasaki and Sone, 2015), marketing (Lee and Shin, 2015), tradition and new value-creation (Ishizuka et al., 2022), apprenticeship (Hori et al., 2020), and recent influence of wine culture (Tseng and Kishi, 2023; Wang, 2019)

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have been analyzed from various perspectives. However, there have been virtually no empirical studies so far analyzing the quality of sake brewing at the brewery level.

While sake brewing is a team effort, there has been no study about what kind of team produces high quality results. Team familiarity has been paid attention to because team performance does not fully depend on the team's past performances and task experience (Huckman et al., 2009). Team familiarity has been actively examined since the 2000s. However, its roots go back further. One of the key points is learning. When team members repeatedly work with one another, they learn with each other and develop a better way of collaborating (Goodman and Leyden, 1991). This has been called social/organizational capital.

Empirical studies have observed positive effects of team familiarity on team performance in different fields, such as software development (Espinosa et al., 2007; Huckman and Staats, 2011; Huckman et al., 2009; Staats, 2012), basketball teams (Grijalva et al., 2020; Sieweke and Zhao, 2015), and medical (Avgerinos and Gokpinar, 2017; Maruthappu et al., 2016; Stucky and De Jong, 2021). However, much of the previous literature has measured productivity, such as postdelivery defects, effort deviation, and team coordination error, rather than innovation. As team members share experiences, they build strong ties, positive social acceptance, and psychologically safe environments, which promote creative problem-solving (Edmondson, 1999; Gruenfeld et al., 1996; Lee et al., 2004; Sosa, 2011).

However, a trade-off between novelty and productivity has been observed repeatedly in the literature on innovation, for example in the automobile (Abernathy, 1978), hard disk drives (Christensen, 1993), shipbuilding (Greve, 2007), and software (Ikuine, 2022). If team members learn and coordinate efficient ways of working together as they repeatedly work together, it may promote efficiency but hamper new exploration (March, 1991). Therefore, this study focuses on the effects of team familiarity on quality superiority rather than productivity.

H1: Team familiarity is negatively associated with quality superiority.

Familiarity is defined as "the knowledge that members of a team have about the unique aspects of their work" (Goodman and Garber, 1988). Such knowledge encompasses not only the understanding of team members but also the task itself (Littlepage et al., 1997). As each task requires unique alignments of machinery, environmental conditions, and operational activities, task familiarity is considered to positively influence task performance across various domains, including mining (Goodman and Leyden, 1991), software development (Banker and Slaughter, 2000; Walz et al., 1993), and medical sector (Reagans et al., 2005). Besides, task familiarity represents a pivotal resource for new product development performance (Wu et al., 2019). As mentioned above, task familiarity is specifically related to the knowledge about team members' principal work (Harrison et al., 2003). The more members in a team with high task familiarity, the faster others will acquire knowledge related to any task. This, in turn, accelerates knowledge exchange within the entire team (Wu et al., 2019).

While undoubtedly essential to achieving organizational goals, task familiarity can also have detrimental effects on team performance in novelty exploration. Arrow and Mcgrath (1993) explore the adverse consequences of heightened task familiarity on team performance, thereby elucidating potential challenges and constraints in the realm of team dynamics (Arrow and Mcgrath, 1993). Task familiarity can precipitate complacency within a team (Choi et al., 2021). When team members have extensive experience in their assigned roles and tasks, their motivation to explore novel approaches or innovations may diminish. This complacency can stifle creativity and limit problem-solving capabilities, as individuals may gravitate toward familiar methods instead of considering innovative solutions (Choi et al., 2021; Goodman et al., 1988; Wood and Lynch, 2002). Moreover, elevated task familiarity can result in a lack of cognitive diversity within a team (Harrison et al., 2003; Mohammed and Nadkarni, 2014). In addition, in a team characterized by excessive task familiarity, there is a tangible risk of stagnation in learning and skill development. The absence of exposure to new challenges and opportunities may hinder team members from acquiring new competencies and knowledge, thereby imperiling the team's overall adaptability and capacity for growth (Eddy et al., 2015). Based on this, this paper proposes the following hypothesis, considering that task familiarity would have a negative impact on novelty-creating team performance.

H2: Team members' task familiarity is negatively associated with quality superiority.

III. Sake brewing team and quality competition

Sake is an alcoholic beverage made from rice, rice malt, yeast starter, and water, which are fermented and then strained. Sake brewing is highly knowledge-intensive. One of the steps requiring a high level of expertise is the multiple parallel fermentation processes. These simultaneous multiple fermentation processes are defined as the two processes of saccharification and fermentation: enzymes in the rice malt turn starch into glucose, and glucose is fermented into alcohol using yeast, proceeding in parallel within manufacturing-use containers. For the manufacture of sake, it is necessary to maintain a good balance between saccharification and fermentation while proceeding with the fermenting process.

A. Sake brewing team

Sake brewing is conducted by a team of brewers supervised by a master brewer called *Toji*. The master gets a contract to brew sake from the sake brewery via a master brewer association's brokerage and takes full responsibility for sake brewing. The master brewer selects and hires his/her team members. Since sake brewing is seasonal, beginning in late September or early October and ending in March, the contracts between the brewery and the master brewer, and between the master brewer and his team member, are on an annual basis. The master brewer assigns his/her chosen team members to roles associated with the sake brewing process. The breweries work together to brew sake at the sake brewery.

Including the master brewer, brewers usually started with simple tasks and gradually engaged in skillful tasks over several years (Hori et al., 2020). Through brewing supervised by the master brewer, chosen brewers not only develop task familiarity

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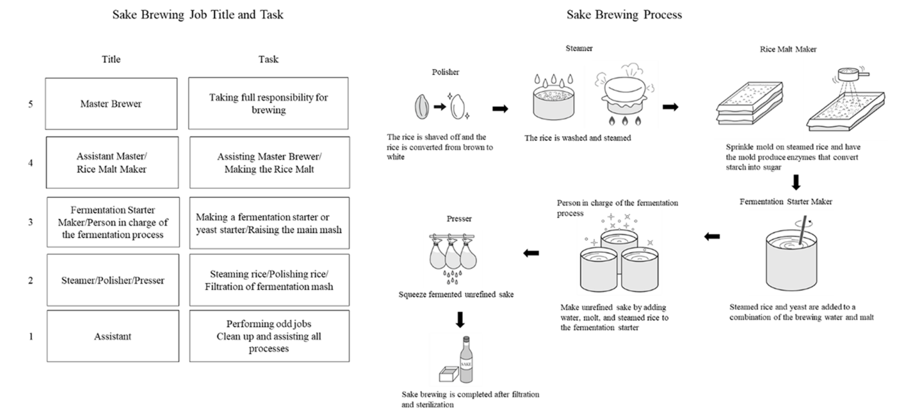

Figure 1. Job title, task, and process.

but also gain an understanding of the brewing process and team management. The brewing tasks are divided in a hieratical manner. As the brewers gain skills, they advance the rank hierarchical career ladder. A typical hieratical ranking system corresponding to each task in the sake brewing process is illustrated in Figure 1. The number on the left of the title signifies the career ladder of brewers. Brewers start their careers as an assistant and move up the ladder. While the number of team members varies depending on the size of the brewing, the typical team size is around five brewers, which corresponds to the sake brewing process illustrated in Figure 1.

As described above, the master brewer is a director of brewing who takes full responsibility for brewing at the brewery. An assistant master brewer plays a supportive role to the master brewer. A polisher shaves off the rice converted from brown to white. A steamer washes and steams the rice. These processes are one of the most important processes in raw material processing. The amount of steam is adjusted according to the condition of the rice. A rice steamer checks the steaming conditions together with the master brewer. Then, a malt maker is in charge of making molt (the rice in which *Aspergillus oryzae* is grown). This manufacturing process requires a relatively high level of expertise, as the result of this process has a significant effect on the quality of the sake. Alongside malt making, a fermentation starter producer is responsible for making a fermentation starter or yeast starter. When adding ingredients, a person in charge of the fermentation process takes control of temperature regulation and facilitates fermentation to make unrefined sake. A presser squeezes the fermented unrefined sake. Newly joined workers perform odd jobs such as cleanup and assistance in the processes noted above. Under this division of labor, sake is brewed as a new product every year.

B. *Quality competition*

We use the results of the national sake quality competition to examine the team's performance. Sales or production costs, which are often used to estimate firm performance, are not available for individual sakes for all breweries. Even if such data were available, the performance of the brewer team is not a single determinant of sake sales or production costs. Complementary assets such as marketing capabilities and negotiating powers with suppliers play important roles in determining sales and costs. However, as explained below, the results of the quality competition are determined solely by the brewing team's performance.

Concretely, we use the results of the Japan Sake Awards. This award has been held annually by the National Research Institute of Brewing (NRIB) and has been the most highly esteemed quality competition in sake brewing in Japan since its start in 1911. It has been the only nationwide quality contest for manufactured sake. Sake brewers who hold a brewing license are allowed to enter the contest. The award provides an important opportunity for breweries to advertise their sake brewing quality. The award is a venue for the master brewers to put their expert skills on display and an opportunity to boost their reputations. Approximately 850 sake products from throughout Japan currently compete here. Each sake is reviewed under the sensory evaluation framework by sake experts based on blind taste tests. From the competing sakes, award winners are recognized as excellent, and gold prize winners are recognized as especially superior. Approximately 30% of the competition entries are given the gold prize. Evaluation reports are returned to each applicant, and award winners are publicly announced. The results of the Annual Japan Sake Awards allow us to investigate the award-winning breweries and the names of their master brewers.

Furthermore, after the sake competition is over, the results of the component analysis of the year's award-winning sake are published annually. The brewers learn best practices from these results. Therefore, if a brewing team is making the same sake as the previous year without reflecting on this analysis, there is little chance of winning an award the following year. Superior product quality with novelty is thus required to be awarded.

It must be noted that sake brewed for the quality competition is not the same sake for consumer markets. Sake for the quality competition is specially brewed and not for sale. The amount of brewing for the competition is conducted generally small scale. Production costs of brewing are usually not considered for brewing for quality competition. Superior quality is important more than cost control. It is necessary to consider production costs when a firm brews sake for consumer markets. However, even if it costs more than what the consumer markets afford, brewers make a great effort to win the gold medal because it is a great opportunity for brewers and breweries to advertise the superiority of their brewing.

The excellence of using quality competition results to examine team performance is twofold. The first is related to the fact that only one sake per brewery is allowed to be entered into the quality competition. Therefore, this allows us to have a clean one-to-one match between the sake exhibited by the brewery and the brewing team that made it by using the result of quality competition and the brewer lists. The second is the fact that the competition results allow us to examine team performance not contaminated by reputation effects. The sake exhibited for this quality competition is evaluated by experts based on sensory evaluation. The experts are appointed by the president of the NRIB from among sake breweries, sake specialists from prefectural research centers, technical officers from the National Tax Agency, and NRIB staff. The experts evaluate sake quality via a two-stage blind tasting. The first stage is preliminary judging, where a sensory profile of each sake is created by characterizing the aroma and taste and by evaluating the overall quality (5-point scale). During the second stage, an overall sensory evaluation is made using a 3-point scale. Although the form of the grade slip has changed, the blind evaluation and the fundamental evaluation criteria have remained constant since 1911.

IV. Data and estimate strategy

Two datasets are needed to examine the impact of team familiarity on innovation. The first dataset is to measure team familiarity. To measure team familiarity, we need the number of times a member has worked with another member in the past. In other words, we need data on the transition of team members over time.

The annual brewer lists of the Nanbu Master Brewer Association (*Nanbu Toji Kyokai*) allow identifying team members and their role. The association, whose precursor was established in 1914, is the largest master brewer association in Japan. The Nanbu Toji Association accounts for nearly 30% of all master brewers in Japan. There are approximately 30 brewers' labor associations in Japan. These associations are organized geographically. The brewer list published annually provides detailed information on all registered brewers, such as their home address, their birthday, the branch to which they belong, tasks they perform, the brewery they work for, and its location. The list allows identifying the team members, the role of members, and their career path. Based on the brewer lists, this study measures team familiarity and task familiarity.

The second dataset is to measure the performance of the team, innovation in particular. This study uses the results of the Japan Sake Awards from 1956 to 2018. The advantage of using this data is that, since the awards are given in a blind tasting, the team's performance can be viewed without the influence of the master brewer on the team or the brewery's reputation. Furthermore, only one sake from a single brewery can be entered for this award, so the team and its performance can be accurately matched.

With these two datasets, this study estimates how team familiarity is associated with innovation by the following model:

$$\begin{aligned} Award_{it} =& \beta_0 + \beta_1 Team\ Familiarity_{it} + \beta_2 Task\ Familiarity_{it} + \beta_3 Team\ Size_{it} \\ &+ \beta_4 Brewery\ Award_{it} + \beta_5 Brewer\ Award_{it} + \lambda_i + u_{it}. \end{aligned}$$

The dependent variable, $Award_{ijt}$, is the dummy variable which takes 1 if a brewing team i in year t wins the gold medal at the national quality competition. Otherwise, it takes 0.

The primary independent variable of interest is *Team Familiarity*. Following the previous literature (Huckman et al., 2009), this study measures team familiarity with the following steps. First, we calculate the number of times each pairing of team members i and j have worked together before the current brewing. We sum this value PW_{ij} over every unique pair on a team to capture team-specific experience, $\sum_{i=1}^{N}\sum_{j=1}^{N} PW_{ij}/N\,(N-1)\,2$, where N is team size. Working with the exact same team member for an additional year raises the *Team Familiarity* by 1.

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We introduce two variables to test how the task familiarity of team members influences team performance. The first is a variable to measure the experience of the master brewer. The variable is *Brewer Task Familiarity*, which counts how many years have passed since a master brewer served as a brewer for the first time. We measure it by using the list of master brewers provided by the Nanbu Master Brewer Association. The second variable, *Individual Task Familiarity*, measures the average task familiarity of team members. As described above, sake brewing is carried out through the division of labor. Each team member has a different experience. For example, some members may have been assistants or steamers for a long time, while others may have been promoted to master brewer with relatively few years of experience in their respective tasks. Therefore, we measure the task familiarity of team members in five distinctive brewing process categories illustrated in Figure 1. The five categories are represented by the subscripts of the variables. We construct the task familiarity variables as follows. *Individual Task Familiarity 5* is the average number of years team members experienced as master brewers. *Individual Task Familiarity 4* is the average number of years team members experienced as assistant master brewers or rice malt makers. *Individual Task Familiarity 3* is the average number of years team members served as fermentation starter makers or persons in charge of the fermentation process. *Individual Task Familiarity 2* is the average number of years team members served as a steamer, polisher, or presser. *Individual Task Familiarity 1* is the average number of years team members served as any other assistant.

In this paper, we control for individual and organizational capabilities that affect novelty-generating team performance by introducing the following two variables. By using the dataset, *Brewery Award* is a variable measuring how many times a brewery previously won the award. We control the master brewer's capability by introducing *Brewer Award*, a variable measuring how many times a master previously won the award by using the Annual Japan Sake Awards' results.

Since many of the breweries are small businesses and unlisted firms, they do not disclose financial information such as sales, operating income, and capital. Therefore, it is difficult to directly measure the size of the brewery. However, we introduce *Team Size*, which counts the number of brewers of a brewing team i in year t. Since geographical conditions such as industrial clustering, climate, and water quality can affect the quality of sake brewing, we control the location of the sake brewery at the prefecture-level as λ.

This paper analyzes the impact of familiarity of the brewing team on brewing performance. In other words, we assume that the cause and effect is the composition of the team members and the result is the performance of the brewery. However, the composition of team members is not randomly determined. A brewery that wants to improve its sake brewing performance may change the composition of its team to achieve that goal. In such cases, it is not only the composition of the team that affects sake brewing performance, but also the possibility of reverse causality. For this reason, we use an external shock, the Great East Japan Earthquake of 2011, as a control variable to estimate causality. The earthquake caused much damage mainly in the Tohoku region. We assigned a dummy value of 1 to the brewers who lived in the special evacuation zone, where the earthquake caused significant damage and the residents were asked to evacuate, and a dummy value of 0 to the other brewers. As those who lived in the special evacuation zone had to move, it is thought that many of them were unable to continue making sake in the same brewery as before. Therefore, it can be assumed that the team familiarity of breweries that employed brewers from the affected areas would be reduced because it would be difficult for the breweries to maintain their original human resources, while the team familiarity of breweries that did not employ brewers from the affected area would not be changed by the earthquake. Since the effects of the earthquake are exogenous to the breweries and affect team composition, but are not expected to directly affect team performance, they are used as an instrumental variable to estimate two-stage probit models to mitigate endogeneity. We use this exogenous shock to examine how team familiarity affects team performance. In the first step, we run an Ordinary least squares (OLS) regression using a dummy variable, *Areas Damaged by Earthqake*, for the special evacuation zone against the endogenous variables, which are *Team Familiarity* and *Task Familiarity*, and obtain the predicted values of the endogenous variable. In the second stage, we incorporate the predicted values from the first stage into the probit model to estimate the relationship between the dependent variable and the explanatory variables.

V. Empirical results

With the Annual Japan Sake Awards and the Nanbu Master Brewer Association's master brewer list, we can cover the quality competition results from 1956 to 2018 and identify 11,866 brewers and 1,003 breweries. Table 1 shows the descriptive statistics of the variables and correlation matrix.

The mean value of *Team Familiarity* is 2.582, and its standard deviation is 2.798. The average year of team members' experience in brewing, *Brewer Task Familiarity* is 12.713 years, and its standard deviation is 11.566 years. The brewer with the most years of experience has 65 years of experience. It is interesting to see the task familiarity when the task familiarity of the brewers is broken down into five tasks. As one moves up from task 1–5, the average year of experience also increases. As noted above, as one moves up from tasks 1–5, the tasks become progressively more advanced. In other words, more advanced tasks require a longer period to become skilled. The correlation coefficient table does not reveal many particularly high correlations among the variables.

Table 2 shows the estimation results of the analysis. We use the logit model to estimate how team familiarity and task familiarity influence team performance because the dependent variable is the dummy variable which takes 1 if a brewing team i in year t wins the gold medal at the national quality competition; otherwise, it takes 0. The results report the odds ratio rather than the coefficient.

Models 1 and 2 are baseline models for team familiarity; Model 2 controls the location of the brewery at the prefecture level, which is not done in Model 1. As we will see later, the odds ratio for *Team Familiarity* is below 1 in all models. This result supports the hypothesis H1b.

Models 3 and 4 introduce task familiarity: Model 3 examines *Brewer Task Familiarity*, which is a proxy for the familiarity on the more general brewing tasks, and Model examines *Individual Task Familiarity 5–1*, which is a proxy for the familiarity on the more detailed subtasks. The odds ratios of task familiarities, both general

Table 1. Descriptive statistics and correlation matrix

	Variable	Obs	Mean	Std. dev.	Min	Max	1	2	3	4	5	6	7	8	9	10	11
1	Awarded	126,621	0.128	0.334	0	1											
2	Team size	117,093	9.083	7.054	1	61	0.104										
3	Brewer award	127,623	1.537	2.429	0	41	0.400	−0.001									
4	Brewery award	127,623	2.141	4.019	0	43	0.466	0.152	0.509								
5	Team familiarity	108,505	2.582	2.798	0.1	32	0.110	−0.069	0.211	0.199							
6	Brewer task familiarity	127,623	12.713	11.566	1	65	−0.014	−0.136	0.536	−0.005	0.216						
7	Individual task familiarity 5	115,755	2.559	6.934	0	57	0.018	−0.102	0.423	0.046	0.109	0.660					
8	Individual task familiarity 5	115,755	3.414	5.726	0	57	0.008	−0.113	0.334	0.010	0.197	0.611	0.074				
9	Individual task familiarity 5	115,755	1.917	3.483	0	39	0.008	−0.089	0.267	0.033	0.156	0.495	0.060	0.245			
10	Individual task familiarity 5	115,755	2.440	3.787	0	42	−0.073	−0.014	0.040	−0.095	0.020	0.250	−0.106	−0.010	0.065		
11	Individual task familiarity 5	115,755	1.771	2.632	0	35	−0.024	0.046	0.098	−0.049	0.038	0.301	−0.006	0.078	0.094	0.098	
12	Areas damaged by earthquake	5,920	0.003	0.052	0	1	0.020	−0.027	0.005	−0.015	−0.040	−0.001	0.008	−0.004	0.000	−0.016	0.001

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Table 2. Estimation results, logit model

	1	2	3	4	5	6	7
Dependent variable				Awarded			
Sample				Full			
Team size	1.032***	1.034***	1.021***	1.021***	1.020**	1.018**	1.020**
	(0.00833)	(0.00866)	(0.00787)	(0.00792)	(0.00785)	(0.00789)	(0.00791)
Brewery award	1.166***	1.154***	1.137***	1.137***	1.139***	1.136***	1.139***
	(0.0228)	(0.0246)	(0.0221)	(0.0223)	(0.0219)	(0.0214)	(0.0221)
Brewer award	1.207***	1.208***	1.380***	1.359***	1.382***	1.387***	1.358***
	(0.0121)	(0.0122)	(0.0229)	(0.0205)	(0.0230)	(0.0245)	(0.0204)
Team familiarity	0.932***	0.943***	0.978*	0.985	0.938***	0.958*	0.949**
	(0.0121)	(0.0130)	(0.0128)	(0.0129)	(0.0230)	(0.0233)	(0.0226)
Brewer task familiarity			0.948***		0.948***	0.903***	
			(0.00388)		(0.00386)	(0.00883)	
Individual task familiarity 5				0.947***			0.935***
				(0.00412)			(0.00984)
Individual task familiarity 4				0.954***			0.941***
				(0.00502)			(0.00897)
Individual task familiarity 3				0.966***			0.951***
				(0.00570)			(0.00806)
Individual task familiarity 2				0.942***			0.936***
				(0.00532)			(0.0102)
Individual task familiarity 1				0.933***			0.918***
				(0.00939)			(0.0131)

(*Continued*)

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Table 2. (*Continued.*)

	1	2	3	4	5	6	7
Dependent variable				Awarded			
Sample				Full			
Team familiarity sq					1.003**	1.002	1.002**
					(0.00116)	(0.00114)	(0.00110)
Brewer task familiarity sq						1.001***	
						(0.000196)	
Individual task familiarity 5 sq							1.000
							(0.000345)
Individual task familiarity 4 sq							1.001
							(0.000412)
Individual task familiarity 3 sq							1.001***
							(0.000466)
Individual task familiarity 2 sq							1.000
							(0.000597)
Individual task familiarity 1 sq							1.001*
							(0.000711)
Brewery location	Not included	Included	Included	Included	Included	Included	Included
Constant	0.0601***	0.0554***	0.0958***	0.0916***	0.103***	0.137***	0.105***
	(0.00647)	(0.0134)	(0.0219)	(0.0201)	(0.0250)	(0.0344)	(0.0248)
Observations	108,259	108,001	108,001	99,761	108,001	108,001	99,761

Clustered standard error in parentheses, $^{***}p < 0.01$, $^{**}p < 0.05$, $^{*}p < 0.1$

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and broken down into subtasks, are below 1, which means a negative association with award winning. This result supports hypothesis H2b.

From Model 1–7, all models but Model 4 shows the negative association between team familiarity and award winning with statistically significance. The results of task familiarities are negative as well. Since some studies have indicated the inverted U-shape relationship between team familiarity and team performance (Katz, 1982; Sieweke and Zhao, 2015), we introduce a squared term for team familiarity and task familiarity in each and examine the possibility that the relationship is U-shaped in Models 5, 6, and 7. The results suggest a U-shaped relationship, since the squared terms for *Team Familiarity* and *Task Familiarity* are statistically significant and have odds ratios greater than 1. The odds ratios of the variable indicate that such a U-shape relation exists. However, they show that the upward effect as suggested by U-shaped relationships is marginal.

Looking at the controlled variables, the odds ratios for *Team Size, Brewery Award*, and *Brewer Award* are all exceeded 1, indicating a positive relation. The odds ratio is particularly great for *Brewery Award* and *Brewer Award*, indicating that excellent breweries and team members who have achieved outstanding results in the past have a high probability of winning awards the next time around, even though the competition is based on blind tasting by experts so that reputation effects can be excluded.

Next, we perform robustness checks using four different models with two-stage probit models. In Table 3, we present the results of the first and second stage estimations for Models 8 to 11, respectively. The first stage estimations are OLS and report coefficients, while the second stage estimations use probit model and reports exponentiated coefficients, which are relative risk ratios (RRR). When RRR is greater than 1, it indicates that the probability of the dependent variable occurring increases as the independent variable increases, and when it is less than 1, it indicates that it decreases.

In the first stage estimation of Model 8, there is a statistically significant negative association between *Team Familiarity* and *Areas Damaged by Earthquake*. And in the second stage results using the predictions from the first stage estimation, the RRR for *Team Familiarity* is 0.79, the same negative relationship observed here. In Model 9, the first-stage results show a negative association between *Brewer Task Familiarity* and earthquakes, but not statistically significant even at the 10% level. This result indicates that although earthquakes work well to address the endogeneity of team familiarity, caution should be exercised with regard to task familiarity. The results of the first stage for Models 9 and 11 show that there is no statistically significant relationship between earthquakes and task familiarity. The reason for this should be related to the brewery's choice of hiring new personnel. If the people who had been working are unable to come to work at the sake brewery due to the earthquake, the sake brewery will have to hire new personnel. Eventually, the value of team familiarity will be decreased, as this is confirmed in Models 8 and 10. However, if the earthquake prevents someone who has been working on a particular task from coming to work, the sake brewery will hire someone who is familiar with the same task. If this is the case, team familiarity will decrease, but task familiarity will remain the same.

Models 10 and 11 use the same estimation as Models 8 and 9, narrowing the sample to 1980 and later. The shorter period used in the analysis is due to the starting point

Table 3. Robustness check, two-stage probit model

	8		9		10		11	
	First stage	Second stage	First stage	Second stage	First stage	Second stage	First stage	Second stage
Dependent variable	Team familiarity	Awarded	Brewer task familiarity	Awarded	Team familiarity	Awarded	Brewer task familiarity	Awarded
Sample	Full		Full		Year > 1979		Year > 1979	
Team size	−0.0834**	0.994	−0.319***	1.002	0.0243	1.033	−0.114	1.022
	(0.0417)	(0.0167)	(0.0995)	(0.0189)	(0.0690)	(0.0284)	(0.157)	(0.0237)
Brewery award	0.0323	1.053***	−0.588***	1.005	−0.00964	1.034**	−0.705***	0.994
	(0.0233)	(0.0126)	(0.0920)	(0.0360)	(0.0285)	(0.0136)	(0.111)	(0.0348)
Brewer award	0.140***	1.102***	2.762***	0.988	0.108***	1.086***	2.734***	0.992
	(0.0305)	(0.0169)	(0.150)	(0.130)	(0.0294)	(0.0152)	(0.155)	(0.147)
Team familiarity		0.790***				0.813***		
		(0.0510)				(0.0619)		
Brewer task familiarity				1.098***				0.915***
				(0.0100)				(0.00623)
Areas damaged by earthquake	−2.944***		−1.529		−3.111***		−2.380	
	(0.746)		(2.974)		(0.895)		(2.855)	
Brewery location	Included	Included	Included	Included	Included	Included	Included	Included
Constant	2.101***	0.268*	12.59***	0.0123***	2.396**	0.255*	13.31***	0.931
	(0.653)	(0.182)	(1.716)	(0.0126)	(0.975)	(0.192)	(2.176)	(0.975)
Observations	4,601	4,471	5,642	5,501	3,600	3,496	4,512	4,393

Clustered standard error in parentheses, $^{***}p < 0.01$, $^{**}p < 0.05$, $^{*}p < 0.1$

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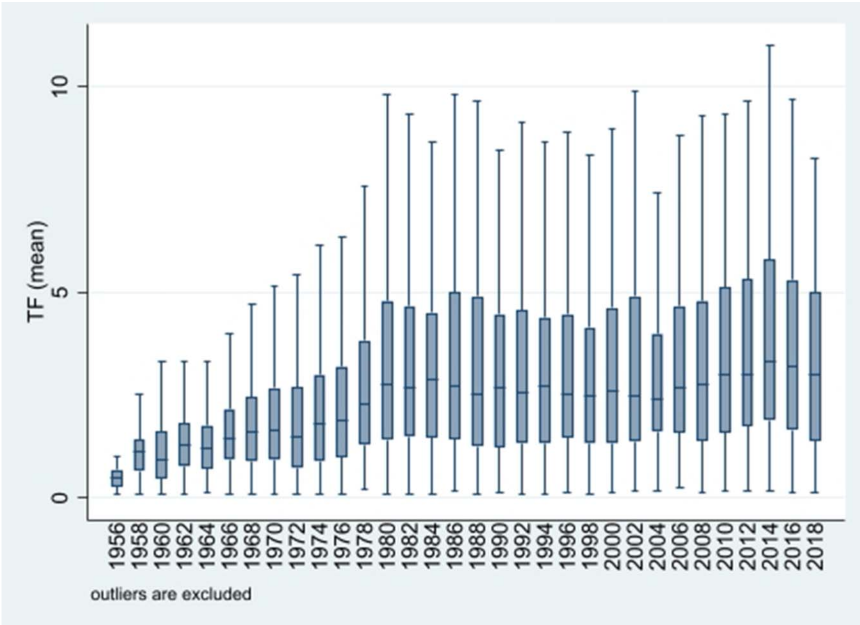

Figure 2. Box plot of team familiarity time series.

constraints of our data. The brewer lists we use to calculate *Team Familiarity* were compiled from 1955. Therefore, 1955 is the first year for calculating *Team Familiarity*. In other words, if a team was brewing sake in 1955, we regard that as the first year the team was organized. However, it is possible that the team was organized before 1955. Figure 2 shows the time series of the *Team Familiarity* box plot from 1955 to 2018.

It shows that the lower quantile, median, and upper quantile have been relatively stable since the 1980s. This is probably an effect of the fact that the team that had started brewing before 1955 was virtually no longer in existence at this time. The results for Model 10 with a restricted sample are generally consistent with those of Models 8. *Areas Damaged by Earthquake* in Model 11 does not function as an instrumental variable for *Task Familiarity* as in Model 9.

VI. Conclusions

By examining sake brewing team and task familiarities and its team performance in quality competition with longitudinal datasets, this study explores how team familiarity and task familiarity influence brewing quality superiority. The empirical results show that the increases in both team and task familiarity are negatively associated with quality superiority.

One of the contributions of this study lies in the datasets. The quality competition data allow us to examine how team familiarity influences highly superior product quality in which novelty is required. And the quality competition results allow us to

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examine the team performance not contaminated by reputation effects because the competition is based on purely blind tasting by experts.

Using data from the earthquake, this paper also estimates the endogeneity between familiarities and team performance, taking into account the endogenous nature of the problem. Firms organize teams to improve certain performance. Naturally, the optimal team should be organized according to the goal. Therefore, there is no relationship in which the organization of teams is completely externally determined and results in team performance. The fact that the exogenously organized warehouses of teams that are different from the previous ones in the earthquake-affected areas are significant is evidenced by the negative relationship between team familiarity and the earthquake. Using this exogenous shock to analyze the relationship between familiarities and brewing quality superiority is one of the contributions of this paper.

The empirical results show that the increases in both team familiarity and task familiarity are negatively associated with team performance. These results suggest that the new information and knowledge inflow are critical for generating high novelty. This is consistent with previous findings in innovation and creativity research (Amabile et al., 1996; Kaiser et al., 2015; Shalley and Perry-Smith, 2008). Furthermore, the results of this study imply that the increase in team familiarity can contribute to exploitation, which has been repeatedly found by the previous literature examining team productivity but can retard exploration (Abernathy, 1978; March, 1991).

The negative impact of task familiarity on team's performance in novelty generating may be one of the key points to focus on. Previous studies have mainly considered an inverse U-shaped relationship between task familiarity and performance. It is believed that while task familiarity up to a certain point is necessary to improve performance, past that point, the opposite is true: performance is negatively affected. However, in the present study, task familiarity is basically observed to have a negative impact. This could be due to two possibilities. First, it is possible that the brewing technique is essentially mature, that each task is clearly defined, and that it does not take much time to learn the task. Second, it is important to note that, as mentioned above, this sake brewing team is not organized solely for the purpose of brewing for the sake competition. The important task of the sake brewing team is to brew sake for the sake competition in order to improve the reputation of the brewery and its brewing techniques, as well as to brew sake for sale to the general public. For this reason, the team is not organized only for sake competitions. Brewing sake for sale to the public with high productivity is probably just as important, if not more so, for a sake brewing team as winning an award at a sake competition. While task-savvy members may play an important role in terms of productivity, this can be seen as having a negative impact in terms of innovation in team performance. To analyze this point, data on productivity is essential. However, since the majority of sake breweries are not listed, they do not disclose financial information such as sales, profits, and assets. If they disclose such information, it allows for examining how team familiarity influences firm productivity in particular. If we could examine not only product novelty but also productivity, we could have explored if a tradeoff exists via team familiarity between innovation and productivity (Abernathy, 1978; March, 1991). This is one of the limitations of this study.

Finally, this study has used data from the national sake quality competitions. This is the largest sake competition in Japan, with over 100 experts blind tasting sake each year. However, while there have been many studies on the reliability of blind tastings in wine research (Berg et al., 2022; Hodgson, 2008; Wang and Prešern, 2018), there have been no such studies on sake. This will be an important area of research in the future.

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