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Emergent Organizational Networks: The Case of Food Hub Managers' Advice Network

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ABSTRACT

The literature on food hubs reveals networks play a critical role in food hub practitioners' ability to gather information useful for their enterprises. However, there is a lack of knowledge on how the practitioners choose from whom to get information or advice. This study examines the role of individual-, tie-, and network characteristics on the likelihood of receiving advice. By collecting data from managers in the U.S. state of Michigan, the study applied the generalized linear mixed-effects regression method. The results show the strength of tie, transitivity, reciprocity, and alter's area of expertise affect the likelihood of receiving advice.

Keywords: *Organizational networks; food hubs; social capital; advice*

1 Introduction

Food hubs are nascent enterprises in the U.S. local and regional food systems. They focus primarily on the aggregation, marketing, and/or distribution of food products sourced from local small- and medium-sized farms and food entities (Barham et al., 2012). Food hubs emerged to strengthen the ability of these producers to access larger buyers (e.g., retailers, institutions, foodservice companies) in local and regional markets (Barham et al., 2012) – beyond local farmers markets and community-supported agriculture (CSA) (Phillips and Wharton, 2015). Although the number of food hubs has grown over the past decade (Feldstein and Barham, 2017), many aspects of a food hub enterprise, such as dominant business model, financial structure, and legal business status, are still in the development stage. As such, there is limited knowledge and prior experiences available for food hub practitioners to draw upon for strategic action and day-to-day operations. The emerging literature on food hubs reveals that formal and informal networks play a critical role in food hub practitioners' ability to gather information useful for their enterprises. Both the 2015 and 2017 National Food Hub Surveys (Colasanti et al., 2018; Hardy et al., 2016) reveal that the top three sources utilized by food hubs to gather information useful for their enterprises include informal networking with food hubs (52 and 63 percent, respectively), formal communities of practice[1] (47 and 49 percent, respectively), and annual meetings or conferences (44 and 66 percent, respectively). Food hub practitioners, moreover, ranked peer-to-peer information sharing as *the most common* (94 percent) way of receiving information useful for their food hubs and *most useful* (66 percent) way of receiving information (Colasanti et al., 2018).

While these findings are useful, there is still a lack of knowledge about the factors that are associated with information-receiving by food hub practitioners through their networks. Information is a specific form of social capital. Research on social networks shows that network ties are a result of individual or collective action (Bourdieu, 1986; Spillane et al., 2012). How do food hub practitioners choose from whom to get information useful for their enterprise? Information is a specific form of social capital and is closely related to advice, another form of social capital (Spillane et al., 2012). While precious research on food hubs did not make an explicit distinction between *information* and *advice* received through food hub networks, the social network studies, in general, make a distinction between the two. As a step forward, this study differentiates *general information* from *advice* useful for food hubs and intentionally focuses on advice because it is one of the strategic resources critical for knowledge development (Spillane et al., 2012; Choo, 1998). New knowledge can be developed when people receive new advice or when they mobilize different pieces of advice (Veflen et al., 2019; Spillane et al., 2012; Choo, 1998).

To enhance the level of social capital in food hubs, in this case receiving advice on how to operate a food hub enterprise, it is important to investigate factors that are associated with the development of this social capital. However, there is a lack of both theoretical and empirical scholarship that identifies factors associated with the development of social capital (i.e., causes of social capital) (Spillane et al., 2012; Small, 2010; Coburn and Russell, 2008). In their efforts to take a step forward in this direction, Spillane et al. (2012) proposed that understanding factors associated with the *existence* of a social tie among actors provides a step forward in the process of understanding/identifying factors that might account for the formation of, or the differences in, social capital among actors. This assumes that social ties among actors are "a necessary condition for social capital because in the absence of such ties, individuals do not have access to social resources" (Spillane et al., 2012, p. 1114). That is, absent social ties, individuals do not have access to social capital. Therefore, this study follows Spillane et al.'s (2012) approach to identifying factors associated with advice-receiving by food hub managers from their professional network members as a way of finding implications for the development of, or differences in, advice-receiving in food hubs.

The purpose of this study is to examine how food hub practitioners (e.g., managers) choose from whom to get advice about operating a food hub enterprise. According to Wellman and Frank (2001:1), "the explanation of who gives what to whom may be in the nature of the giver and receiver, the relationship, or in the composition and structure of the network in which people and ties are embedded." Therefore, this study examines the role of individual-, tie- and network characteristics in shaping receiving advice about operating a food hub enterprise. This study draws from the social network theories, with an emphasis on the theory of social capital and social tie formation, to better understand the dynamics of advice-receiving in food hub managers' professional networks. It is important to note that this is the first study in the food hub literature attempting to empirically examine food hub networks.

This paper is organized as follows. Section 2 describes the empirical framework used to examine the individual-, tie- and network characteristics in shaping advice received by food hub managers along with the hypotheses of the study.

[1]There are at least eight formal food-hub related networks in the U.S. Examples are the Michigan Food Hub Network, Iowa Food Hub Managers Working Group, a California network coordinated by the UC Sustainable Agriculture Research and Education Program at the University of California-Davis, and the Tap Root Collaborative on Colorado. There are also at least two emerging networks (Colasanti et al., 2018).

Section 3 presents the methods employed to collect and analyze data. Section 4 presents the results and discussion of the study. Finally, the paper concludes with final remarks and implications.

2 Theoretical Background

2.1 Social capital

Social capital denotes "real or potential resources for action that are attained *through relationships*" (Spillane et al., 2012: 1113). These resources take different forms such as trust, goods, services, information, advice, social obligation, social support, and social norms (Arias and Fromm, 2019; Spillane et al., 2012; Inkpen and Tsang, 2005; Nahapiet and Ghoshal, 1998; Coleman, 1988). Social capital is embedded in social relationships or networks, which leads to individual or aggregate benefits in a given society (Jackson, 2008). Unlike other forms of capital (e.g., physical, financial, human), social capital is embedded in social relationships among actors. Like other forms of capital, social capital fosters productive activity, making it possible to achieve certain outcomes that would not be possible in its absence (Coleman, 1988).

The majority of literature on social capital has studied the type of resources embedded within social networks, the effects of social capital at the individual, group, and organizational level, as well as the nature of the organizations of social relations (Spillane et al., 2012; Lin, 1999). In entrepreneurship research, studies on social networks focus on the entrepreneurs' access to intangible resources (Hoang and Antoncic, 2003). Through network relations, entrepreneurs get access to resources such as emotional support in risk-taking situations (Bruderl and Preisendorfer, 1998), information and advice, problem solving, business information (Johannisson et al., 1994), know-how (Brown and Butler, 1995), and reputation. Access to these different forms of social capital, in turn, results in valued entrepreneurial outcomes such as enhancing the level of persistence in an entrepreneur to stay in business in risk-taking situations (Gimeno et al., 1997), acquiring key talent (Freeman, 1999), getting new ideas, recognizing entrepreneurial opportunities (Wiśniewska-Paluszak and Paluszak, 2019; Smeltzer et al., 1991; Birley, 1985), enhanced access to key strategic resources, and mitigating perceived risk through legitimacy (Stuart et al., 1999).

In social networks, according to Wellman and Frank (2001:1), "the explanation of who gives what to whom may be in the nature of the giver and receiver, the relationship, or in the composition and structure of the network in which people and ties are embedded." Therefore, this study examines individual-, tie-, and network-specific characteristics in shaping advice receiving about operating a food hub enterprise. Individual characteristics refer to specific attributes of food hub managers (i.e., egos) and people in their social networks (i.e., alters). Tie characteristics refer to specific attributes of a dyad in a network. Network characteristics refer to composition and structure of a given network.

In formulating working hypotheses about individual-, tie-, and network-specific characteristics that may account for receiving advice about operating a food hub enterprise, this study draws from the theory of social capital and theories of tie formation.

2.2 Individual characteristics

Individual characteristics refer to specific attributes of food hub managers (i.e., egos) and people in food hub managers' social networks (i.e., alters). Both ego and alter characteristics are important factors in identifying receiver- and giver-effects in social networks, because part of the explanation of who gives what to whom may be in the nature of the giver and/or receiver (Wellman and Frank, 2001). Taking into consideration the small sample size of this study (i.e., seven food hub managers), specific individual characteristics of food hub managers (i.e., egos or advice-receivers) are not hypothesized and examined. Instead, ego characteristics are modeled in this study as a dummy variable which will still allow for identifying the overall effect of individual characteristics of food hub managers in their advice-receiving networks. This study incorporates only alter characteristics (i.e., giver-effect) as the sample size for alters is much larger (N=64) (see Methods section of this study).

Alter's expertise is one of the key factors in advice-receiving networks (Nebus, 2006). Ego's perceptions of who the experts are in their social networks are directly affected by the nature of the task being addressed (Nebus, 2006). Experts are individuals who specialize in a specific domain(s), present problems within a specific domain(s) at a deeper level (Nebus, 2006; Simon, 2000; Chi et al., 1988), diagnose and solve problems quickly due to a certain intuition based on their experience (Nebus, 2006; Prietula and Simon, 1989). Within the context of food hubs, there are several domains or functional areas that are critical for food hub operations, namely food safety (Matson et al., 2013; Matson and Thayer, 2013), operations management, product sourcing/producer networks, customer relations (Diamond and Barham, 2012), human resource management, and funding (Colasanti et al., 2018). As they manage food hubs, it is expected that the managers might have questions or need advice related to one or more of these functional areas. Hence, it is expected that food hub managers will tend to connect with individuals that they perceive to be experts in one or more of these areas. Following this logic, the following hypothesis is formulated:

Hypothesis 1: *Food hub managers are more likely to receive advice from network members who are perceived to be experts in a domain(s) specific to food hubs. (These domains include food safety, operations management, product sourcing/producer networks, distribution, customer relations, human resource management, and/or funding).*

Another key attribute of an alter in food hub managers' advice-receiving networks is the number of years the alter has been involved in a food hub or related organization. This notion is directly related to a concept known as *cognitive trust* in a network. Cognitive trust, also known as calculus-based trust, is a specific dimension of trust reflecting an individual's competence, professionalism, ability, and past performance (Nebus, 2006). As Nebus (2006: 628) states, "these traits create a halo effect, which may result in this person's being perceived as desirable, even though he or she is not an expert in the pertinent field of study." Food hubs are nascent enterprises in the U.S. food system. Therefore, individuals who have been involved in the process longer will more likely be perceived as more trusted in terms of starting or operating a food hub. They may not necessarily be experts in specific domains, but they might be perceived to be more aware of sources of resources necessary for food hub survival and growth. Thus, these alters will be perceived as trusted and food hub managers will be more likely to receive advice from them. Based on this logic, the following hypothesis is formulated:

Hypothesis 2: *The longer the network member has been in a food hub or related organization, the more likely it is the food hub manager will receive advice from them.*

According to the theory of social exchange, individuals establish relationships to exchange valuable resources such as information, material goods, skills, and the like (Zhu et al., 2013). One of the ways to identify and explain the dynamics of social exchange in a network is through the degree of reciprocity. In general, a high degree of reciprocity indicates that individuals choose each other in a network (Valente, 2010). Following this logic, egos will likely tend to receive resources from alters with whom they have current or prior exchange relationship. The exchange does not necessarily need to be regarding the same type of resource. In general, in the context of expertise, reciprocity is expected to be lower. The reason is that individuals with less expertise in a given subject area will seek advice from those alters who have higher levels of expertise in the same subject area. This implies that alters with higher levels of expertise (compared to the ego) are less likely to seek advice from the ego in the same subject area. On the other hand, if the ego provided advice to the alter in a different subject area in the past, it is expected that the alter will reciprocate and provide advice to the ego about a food hub-related topic. Following this logic, the following hypotheses are formulated:

Hypothesis 3: *Food hub managers are more likely to receive advice from network members to whom they did not provide advice about food hub-related subject area in the past.*

Hypothesis 4: *Food hub managers are more likely to receive advice from network members to whom they provided advice in other subject areas (i.e., other than food hub-related subject area) in the past.*

2.3 Tie characteristics

Tie characteristics refer to specific attributes of a dyad in a network. As stated earlier, part of the explanation of who gives what to whom in a network may be in the nature of the relationship (Wellman and Frank, 2001). One of the key characteristics of a tie that connects an ego to an alter in an egocentric network is its strength. The higher or lower the frequency and intensity of interaction between an ego and alter, the stronger or weaker the tie is, respectively (Monge and Contractor, 2003). Previous research shows that strong ties provide more social support (e.g., emotional aid, material aid, information, and companionship) than weak ties (Wellman and Frank, 2001; Wellman and Wortley, 1990). Weak ties, on the other hand, have shown to provide other benefits such as finding jobs (Granovetter, 1973). In the context of food hubs, it is expected that food hub managers will receive advice regarding a food hub related problem or food hub related decision they have to make from individuals in their professional networks with whom they interact more frequently and communicate with for a longer amount of time during each interaction. This notion is rooted in the assumption that food hub managers would consider reaching out to or share with people in their professional network while encountering a food hub related problem or when they have to make a food hub related decision (alone or with others). Because of the dynamic nature of the tasks being completed in food hubs, it is expected that food hub managers will receive advice from individuals with whom they have strong ties because they interact with these individuals more frequently and for a longer amount of time during each interaction. According this logic, the following hypothesis is formulated:

Hypothesis 5: *The stronger the tie between the food hub manager and the network member, the more likely it is the food hub manager will receive advice from them.*

Another tie-level characteristic that has shown to play a role in advice-receiving networks is homophily. Homophily is a property that refers to the fact that people tend to maintain relationships with people who are similar to themselves. Homophily is measured in various ways, including age, gender, race, religion, profession, and the like. It can have important implications for how the information or behaviors are spread (Jackson, 2008). Burton (1927) was the first

author who formalized this property in social networks and framed it as "birds of a feather" (Jackson, 2008). Previous research shows that homophily influences whom a person consults for advice. A greater likelihood of response is expected from individuals with similar demographics. Researchers have also found that individuals seeking technical advice, for example, have a greater tendency to ask others of the same gender, age, and organizational tenure (Nebus, 2006; Zenger and Lawrence, 1989; Ibarra, 1992). In this study, homophily in terms of common interest is emphasized. Specifically, within the context of food hubs, attendance in common meetings or conferences shows that egos and their alters have common interest. This also provides a venue for potential interactions between egos and alters. Additionally, from the transaction costs perspective (Williamson, 1985), egos spend fewer resources accessing advice from their alters in case of attendance in common meetings. In the context of food hubs, the managers are more likely to receive advice directly during the meetings or conferences related to food hubs. Moreover, these meeting and conferences create a sense of belonging and proximity, which, in turn, fosters the resource flow in the form of advice between egos and alters. Thus, based on the literature, the following hypothesis is formulated:

> ***Hypothesis 6:*** *Food hub managers who attend common meetings with the network member are more likely to receive advice from the network member.*

2.4 Network characteristics

Network characteristics refer to the composition and structure of a given network. Characteristics of a network affect its overall dynamics. A measure of network structure that has shown to play an important role is transitivity. In an egocentric network, transitivity exists when the following combination of links between three nodes exists: Ego chooses an alter 1 (A1), A1 chooses A2, and ego chooses A2. That is, a triad is considered transitive if two of the nodes have the same relationship with the third node (Valente, 2010). According to the Balance theory (Heider, 1958), the ego chooses A2 because individuals prefer having a balanced environment around them. In the case of food hubs, the effect of transitivity is reflected in situations when a food hub manager and one of the alters have a third mutual tie. In this case, the likelihood that the food hub manager will receive advice from this alter is higher. Based on the literature, the following hypothesis is formulated:

> ***Hypothesis 7:*** *The greater the number of mutual ties between a food hub manager and the network member, the more likely it is that the food hub manager will receive advice from the network member.*

It is important to note that the list of hypotheses and identified variables are not exhaustive. Rather, this study serves as a starting point for empirical studies on food hub networks. The list of variables was identified and hypotheses were formulated based on social network theories.

3 Methods

This study employed egocentric network design (Henning et al., 2012; Hanneman and Riddle, 2005) to collect data from food hub managers (i.e., egos). It focuses on food hubs in the U.S. state of Michigan (MI). There are ten actively operating food hubs in MI. All 10 food hub managers were contacted via email and were invited to participate in the survey. Once agreement was received, the hard copy of the survey questionnaire was sent to them via mail along with a prepaid return envelope. These steps were completed during mid-January to early March of 2020. Participants received $50 Amazon gift cards as a thank you for their time once the completed questionnaires were received. The gift cards were sent via Amazon.com. Seven out of ten food hubs completed and returned completed surveys. Each of the food hub managers nominated eight to ten alters in their networks resulting in a sample size of 64 for alters. The data was digitized and coded for analysis purposes.

The actors (i.e., nodes) of the network are defined as follows: the respondent food hub manager is an "ego" in this study. Individuals listed by egos as members of their food hub-related professional networks are "alters" (i.e., nodes in an egocentric network). The type of tie under study is an advice-receiving tie (i.e., ego received advice from an alter).

Food hub managers (i.e., egos) were first asked to nominate 8-10 individuals outside their organization with whom they had business or professional conversations about food hubs during the past 12 months. This specified the boundaries of the ego's network. From this list, managers were asked to specify those individuals from whom they *received advice.* This advice might have been for a food hub related problem or decision that the manager had to make alone or with others during the past 12 months (for a similar approach see Agneessens and Wittek (2012) and Brennecke and Rank (2017)). The questionnaire also included questions about alters that egos would most likely be able to answer. Ideally, alter characteristics would have been collected directly from alters. However, due to confidentiality reasons egos were asked to specify alter characteristics.

To test these working hypotheses, an empirical model (1) was specified (see below). In the model specification, the dependent variable is the likelihood of receiving advice. That is, a model for likelihood of receiving advice as a function of individual-, tie-, and network characteristics is estimated. Since the sample size in terms of egos for this study is small

(i.e., seven food hub managers), specific individual characteristics of egos (i.e., advice-receivers) were not examined. Egos were assigned dummy variables to account for ego-specific characteristics associated with advice-receiving.

The empirical model was estimated following the generalized linear mixed-effects regression method and using R software. This method allows for considering fixed effects (i.e., variables specified in the model) and random effects (i.e., ego characteristics specified by a dummy variable). It also allows for addressing the non-independencies aspect of network data (Winter, 2013). Additionally, descriptive statistics are reported to provide a better understanding of the network under study.

The empirical model is specified as follows:

$$\log\left[\frac{P(Receiving\ Advice_{ij}=1)}{1-P(Receiving\ Advice_{ij}=1)}\right] = \beta_{0j} + \beta_1\, Alter's\ Area\ of\ Expertise_{ij} \quad (1)$$
$$+ \beta_2\, Alter's\ Number\ of\ Years\ in\ Food\ Hub\ or\ Related\ Org_{ij}$$
$$+ \beta_3\, Ego\ Provided\ Food\ Hub\ Related\ Advice\ to\ Alter\ in\ Past_{ij}$$
$$+ \beta_4\, Ego\ Provided\ Other\ Advice\ to\ Alter\ in\ Past_{ij}$$
$$+ \beta_5\, Strength\ of\ Tie_{ij}$$
$$+ \beta_6\, Attendance\ in\ Common\ Meetings_{ij}$$
$$+ \beta_7\, Mutual\ Ties\ Between\ Ego\ and\ Alter_{ij}$$
$$+ \beta_8\, Dummy\ Ego_i$$
$$+ \varepsilon_j$$

where the subscript i stands for ego i, and j stands for alter j. Egos were assigned dummy variables and their characteristics were treated as random effects. See Table A1 in Appendix for operationalization of variables in the empirical model.

4 Results

Figure 1 shows organizational affiliation of network members from whom food hub managers received advice. The top three affiliations are with university/college/extension (28 percent), food-related for-profit business (15 percent), and food hubs (13 percent). Additionally, food hub managers perceived most of the advice received from alters as very useful; none of the received advice was characterized as not at all useful.

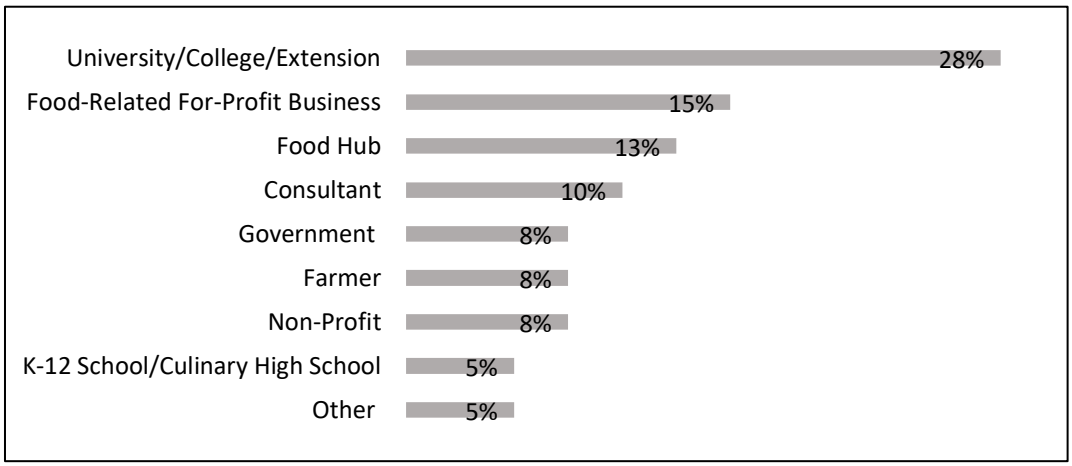

Figure 1: Organizational affiliation of alters from whom managers received advice

Notes: [1]The category "Other" included responses such as a food-related marketing agency. [2] "K-12" stands for kindergarten (K) and the 1st through the 12th grade (1-12) - the publicly-supported school grades prior to college.
[3]Of the 64 network members, 39 were indicated to be individuals from whom food hub managers received advice. Therefore, in this figure N=39.

The results of the generalized linear mixed effects regression show that the strength of tie, transitivity, reciprocity, and an alter's area of expertise have a statistically significant effect on the log odds of the ego receiving advice from the alter (see Table 1). First, as a tie-level characteristic, the strength of tie has a significant positive effect (at five percent level) on the log odds of receiving advice from the alter ((β5 =1.846). That is, the likelihood of receiving advice from the alter tends to be higher as the strength of the tie between the ego and alter increases. Thus, hypothesis five is supported. This finding suggests that food hub managers are more likely to receive advice from alters with whom they interact more frequently and for a longer amount of time during each interaction.

Second, as a network-level characteristic, transitivity (i.e., mutual ties) has a significant effect (at five percent level) on the log odds of the ego receiving advice from the alter (see Table 1). The positive value of the coefficient (β7 =1.739) indicates that as the number of mutual ties between the ego and alter in an egocentric network increases, the odds of the ego receiving advice from the alter increase. Thus, hypothesis seven is supported. This finding suggests that food hub managers whose food hub-related professional networks have high levels of transitivity are more effective in terms of receiving advice from network members. That is, the likelihood of receiving advice from network members is higher in transitive networks. This finding is consistent with the broader literature on trantivity which states that high level of transitivity in a network is indicative of cohesiveness as well as effectiveness in a broader sense (Valente, 2010). This finding is also consistent with the balance theory (Heider, 1958), according to which people prefer a balanced environment with the people around them. Accordingly, having a mutual tie(s) with an alter increases a food hub manager's likelihood of receiving advice from an alter.

Third, advice-receiving about food hub-related topics is reciprocated. That is, "ego provided food hub-related advice to alter in the past" is statistically significant (at five percent level). The positive value of the coefficient (β3 = 2.914) indicates that a food hub manager's likelihood of receiving advice from a network member increases if the manager provided food-hub related advice to the network member in the past. This means that hypothesis three is supported, but the coefficient is, contrary to expectations, positive instead of negative. Hypothesis four, on the other hand, claimed that if food hub managers provided advice to alters about other topics (unrelated to food hubs) in the past, then the likelihood of a food hub manager receiving advice from the alter would be higher. That is, it was expected to see positive association between the two variables. However, as can be seen from Table 1, the negative value of the coefficient for this variable (β4 = -1.264) indicates that if a food hub manager provided advice about other topics (unrelated to food hubs) to an alter in the past, then the odds of receiving advice from the alter decreases. This result, however, is not statistically significant.

Finally, as can be seen from Table 1, alter's area of expertise in operations management has a significant and positive effect (at one percent level) on the log odds of the ego's receiving advice from the alter (β1 = 3.228). That is, the likelihood of a food hub manager receiving advice from the alter tends to be higher if the alter is perceived to be an expert in operations management. Thus, hypothesis one is supported. It is important to note this study originally included several areas of expertise of alters to be tested (see Hypothesis 1). However, due to the sample size restrictions, only one specific area was included in the model specification. In order to decide which area of expertise to include in the model, eight separate specifications of the empirical model with each of the eight area of expertise were tested. The specification with the lowest Akaike information criterion (AIC) was selected for final reporting.

Table 1.

Generalized linear mixed-effects regression results for fixed effects.

Variable	Estimate	Standard Error	P-value	Hypothesis (Supported/Refuted)
Intercept	-0.546	1.081	0.613	
Alter's area of expertise (in operations management)	3.228	1.227	0.008 **	H1 (S)
Alter's number of years in food hub or related org.	0.045	0.755	0.952	H2 (R)
Ego provided food hub-related advice to alter in the past	2.914	1.268	0.021 *	H3 (S)
Ego provided advice to alter about other topics in the past	-1.264	1.550	0.414	H4 (R)
Strength of tie	1.846	0.914	0.043 *	H5 (S)
Attendance in common meetings (met once)	1.774	1.907	0.352	H6 (R)
Attendance in common meetings (met several times)	-0.090	1.264	0.942	H6 (R)
Transitivity (mutual ties)	1.739	0.748	0.020 *	H7 (S)
Number of observations	64			

Note: ˙, *, **, and *** represent significance at 10, 5, 1, and 0.1 percent level respectively. AIC=58.4. The table reports standardized parameter estimates. Ego characteristics were treated as random effects.

Table 2 shows the generalized linear mixed-effects regression results for the random effects. The standard deviation is a measure of the variability for each random effect added in the model. As can be seen from the results, the ego dummy's variability is 0.831. That is, there are idiosyncratic differences between egos. This result suggests that there

are differences in individual characteristics of food hub managers that play a role in their likelihood of receiving advice.

Table 2.
Generalized linear mixed-effects regression results for random effects.

	Variance	Standard Deviation
Ego Dummy (Intercept)	0.690	0.831
Number of observations	64, groups: Ego Dummy, 7	

R-squared of the empirical model

Table 3 shows the R-squared value of the model. *R-squared marginal (m)* is the proportion of the variability in the dependent variable that is explained by only the fixed effects in the model. The *R-squared conditional (c)* is the proportion of the variability in the dependent variable that is explained by the fixed effects *and* the random effects in the model. The results show the fixed effects in the empirical model explain 78.8 percent of the variability in the data. When adding in the random effects, there is 3.6 percent increase of the variability, which suggests that the random effect of ego characteristics account for 3.6 percent variability in the dependent variable (i.e., ego's likelihood of receiving advice). This finding suggests that the random effect of individual characteristics of egos (i.e., food hub managers) plays a role in the likelihood of receiving advice from network members. As mentioned earlier, this study did not specify individual characteristics of food hub managers due to small sample size. Assigning a dummy variable for the egos still allows accounting for the overall effect of ego-specific characteristics.

These results have two important implications for future research. First, an R-squared of 78.8 percent for the fixed effects suggests that there are other alter-, tie-, and/or network-specific variables that may account for the variability in the dependent variable that were not included in the empirical model. Identifying and incorporating more factors would potentially allow better understanding the advice-receiving networks of food hub managers. Second, an R-squared of 82.4 percent for the fixed *and* random effects suggests that food hub managers' individual characteristics affect variability in the data. Therefore, future research can also identify and empirically examine specific characteristics of food hub managers as predictor variables in the likelihood of receiving advice.

Table 3.
R-squared of the generalized linear mixed-effects regression model.

	R-squared m (fixed effects)	R-squared c (fixed effects *and* random effects)
Theoretical	0.788	0.824

Note: *R-squared m* is the proportion of the variability in the dependent variable that is explained by only the fixed effects in the model. The *R-squared c* is the proportion of the variability in the dependent variable that is explained by the fixed effects *and* the random effects in the model.

5 Discussion

5.1 Strength of tie

The results showed the strength of tie has significant effect on food hub manager's likelihood of receiving advice. One explanation for this finding could be that when food hub managers face a food hub-related problem or decision, they are more likely to discuss it with individuals in their professional networks with whom they meet more frequently and spend longer amounts of time during each interaction. This could also point to the reality that food hub operations are dynamic and food hub managers need faster turnaround in terms of finding solutions for problems. Therefore, strong ties tend to provide advice useful for food hubs. This finding has important implications for food hub managers. Specifically, the results point to the importance of the strength of tie in food hub-related professional networks. Food hub managers that invest time and effort to build relationships in the field are shown to benefit from them. That is, allocating time to meet up with network members regularly and spending a longer amount of time during each interaction can have positive effects on food hub managers' advice-receiving process. This reinforces the notion that in order to increase the level of social capital—in this case advice—in food hub managers professional networks, they would need to be intentional about the frequency of interaction and duration of meetings with network members.

5.2 Transitivity

The findings of this study showed that high levels of transitivity in food hub managers' egocentric networks increase the likelihood of receiving advice from alters. That is, mutual ties between the food hub manager and a network member play an important role in a food hub manager's likelohhod of receiving advice from the network member. This finding has important implications for food hub managers in terms of designing or revising their food hub-related

networking strategies. As mentioned earlier, the formation, maintenance, and/or resolution of network ties require resources such as human and financial capital (Monge and Contractor, 2003). Therefore, for food hub managers, part of the effective management of resources is to assess their own food hub related networks to be able to manage these networks effectively and efficiently.

5.3 Reciprocity

The results showed advice-receiving about food hub-related topics is reciprocated. This finding was surprising as, in general, in the context of expertise, reciprocity is expected to be lower. The reason is that individuals with less expertise in a given subject area tend to seek advice from those alters who have higher levels of expertise in the same subject area. This implies that alters with higher levels of expertise (compared to the ego) are less likely to seek advice from the ego in the same subject area. In the case of food hub managers and the alters, this was not the case. They provided food hub-related advice to each other. One possible explanation for this result could be that in the field of food hubs, there are no "defined experts" where the flow of the advice is one-sided in most cases. These results might point to the reality that most people in the field are learning from each other; therefore, advice about food hub-related topics is reciprocated.

5.4 Alter's area of expertise (in operations management)

Food hub manager's network members' expertise in operations management is a significant factor in their likelihood of receiving advice. Operations management is one of the key functional areas of food hubs. This result is consistent with the literature that people who are experts in specific domains play a key role in advice-receiving networks in these specific domains. Within the context of food hubs, one possible explanation for this result could be that alters perceived to be experts in operations management play a critical role in these advice-receiving networks. Additionally, this result might point to the possibility that operations management is one of the areas in which food hub managers needed advice when they faced a problem or decision that they had to make alone or with others. That is, in-house expertise might have not been sufficient to solve the problem(s) or make the decision(s). Food hub managers thus sought advice from within their professional networks. This finding has important implications for increasing the level of social capital under study—advice—for food hubs. Operations management is one of the key functional areas of food hubs and, according to the findings, the managers have benefited from external advice in this field. Therefore, food hub managers might benefit from training or other capacity-building initiatives regarding operations management to help food hubs become more successful.

6 Conclusion and Implications

This study examined food hub managers' advice networks. The results show that food hub managers' advice network members are individuals affiliated with various organizations. The top three organizational categories are universities/colleges/extensions, for-profit food businesses, and food hubs. Additionally, food hub managers perceived most of the advice received from alters as very useful; none of the received advice was characterized as not at all useful.

The regression results showed that network-, tie-, and individual-characteristics played a role in food hub managers' likelihood of receiving advice. Specifically, the strength of tie, transitivity, reciprocity, and alter's area of expertise in operations management affect the likelihood of receiving advice. These findings have important implications for increasing the level of social capital—in this case advice—in food hub managers' professional networks as well as for designing or revising their strategies. The formation, maintenance, and/or resolution of network ties require resources such as human and financial capital (Monge and Contractor, 2003). Therefore, for food hub managers, part of the effective management of resources could be assessing their own food hub-related professional networks to be able to manage these networks effectively and efficiently. First, a high level of transitivity in a food hub manager'a egocentric networks increases the likelihood of receiving advice from alters. This may suggest that food hub managers whose network members know each other are more effective in terms of receiving advice.

Second, the stronger a tie between a food hub manager and an alter, the more likely it is the food hub manager will receive advice from the alter. This finding suggests that food hub managers receive advice from individuals they interact with more frequently and for a longer amount of time in each interaction. Further, this finding points to a possibility that food hub managers that invest time and effort to build relationships in the field are shown to benefit from them. This reinforces the notion that in order to increase the level of receiving advice in food hub managers' professional networks, they must be intentional about the frequency and duration of interaction with network members.

Third, an alter-specific characteristic that played a role in food hub managers' likelihood of receiving advice was the alter's area of expertise (perceived by egos) in operations management. This result reinforces the notion that

operations management is a critical part of food hub operations and food hub managers received advice from individuals who were perceived as experts in this area. This also suggests that operations management is an area that food hub managers may need additional capacity building. Therefore, it might be helpful to have capacity building efforts for food hub managers in the form of organizing trainings or other capacity-building initiatives in the area of operations management.

Fourth, food hub-related advice was shown to be reciprocated suggesting that proactively investing in food hub-related professional networks (i.e., providing food hub-related advice to others) will potentially serve as a source of resource flows in the form of food hub-related advice for food hub managers.

This study is the first attempt in the field of food hubs to model and examine social capital in the form of advice in food hub managers' professional networks. It informs practitioners about the key factors that play a role in receiving advice in food hub managers' professional network. It also reinforces the importance of the professional networking strategies in the field of food hubs based on the food hubs in Michigan. Future research can use this approach and test this model with a larger sample size of food hub managers.

One limitation of this study is that it did not incorporate characteristics of egos (i.e., food hub managers) into the model due to a relatively small number of food hubs (therefore, smaller number of managers) in the state of Michigan (which was the scope and focus of the study). These results will serve as a basis for future research to build on more empirical studies in the field. Increasing the sample size and incorporating specific characteristics of food hub managers into the empirical model will further enhance the understanding of food hub managers' advice networks.

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Appendix

Table A1.
Operationalization of variables included in the empirical model.

Variable	Code and description
Ego received advice from the alter (Dependent Variable)	1=Yes; This advice might have been for a food hub related problem or with a food hub related decision that ego had to make alone or with others in the past 12 months.[2] 0=No; Ego did not receive advice from the alter. They simply had general professional conversation(s) about food hubs.
Strength of tie	Frequency of communication x Duration of conversation Frequency of communication with alter: 1=once in the past 12 months; 2=several times in the past 12 months; 3=monthly; 4=weekly; 5=daily Duration of a typical conversation with alter: 1=less than 15 minutes; 2= "15-20" minutes; 3= "31-60" minutes; 4= "1-2" hours; 5=more than 2 hours
Alter's area of expertise	1=Yes; 0=No; Product sourcing/producer networks; Operations management; Food safety; Human resource management; Funding; Distribution; Customer relations; Other.
Alter's number of years in food hub or related organization	Numerical value
Homophily: Attendance in *common* meetings and conferences: Ego saw alter in these meetings or conferences	0=No; 1=yes, once in the past 12 months; 2=yes, several times in the past 12 moths List of meetings and conferences (primarily in Michigan): Great Lakes EXPO, Michigan Farm to Institution Network Meeting, Michigan Food Hub Network Meeting, Michigan Food and Farming Systems Family Farms Conference, Michigan Good Food Charter Communities/Meetings, Michigan Food and Agriculture Summit, Northern Michigan Small Farms Conference, Other (please specify).
Reciprocity: (a) Ego provided alter with food hub-related advice in the past, (b) ego provided alter with other topic-related advice in the past	1=Yes, 0=No
Transitivity: Mutual ties between ego and alter	1=Yes, 0=No; Faction of mutual ties converted to percentage according to the following formula: Number of mutual ties in an egocentric network between the ego & the alter/(Total number of alters in the egocentric network - 1) x 100

[2] Note: "In the past 12 months" refers to the time period that respondents would recall at the time of taking the survey (late January-early March, 2020).