Employer Cooperation in Referral Networks*

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Abstract

How do employers, competing in the same markets, achieve to cooperate? In dyads, cooperation evolves if pairs of actors interact repeatedly. Third actors support such dyadic cooperation by circulating information on actors' past behavior allowing actors to avoid non-cooperators. This paper focuses on the role of these third actors in cooperative networks. It shows that third actors establish local hierarchies (transitive triads), rather than horizontal connections (cycles). Local hierarchies may reflect actors' desire to achieve prestige by connecting to higher-standing actors. Empirically, the paper analyzes how employers cooperate in networks by exchanging information on prospective employees (referral networks). It analyzes eight local referral networks in two different economic sectors based on exponential random graph models. Results show that triadic closure in these networks takes a hierarchical (transitive) form, rather than one of horizontal exchange (cycles). This finding is interesting considering the literature highlighting reciprocity as an important factor facilitating cooperation.

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1 Introduction: Hierarchical triads versus horizontal triads

A social dilemma designates a situation in which individual and collective rationality diverge. Actors, or organizations, are said to cooperate, when they decide for the greater good rather than follow their self-interest, without being forced to do so by a higher authority (Elster, 1989, p. 40). The literature on cooperation analyses how individual actors manage to cooperate in absence of a higher authority (Kollock, 1998, p. 192). It has been shown that actors care about reciprocity or fairness and can be motivated to cooperate (Fehr and Schmidt, 1999, p. 837; Fehr and Fischbacher, 2004, p. 187; Winter, Rauhut, and Helbing, 2012, p. 929; Irwin and Simpson, 2013, p. 1069). Alternatively, they can be deterred from non-cooperation by making their non-cooperative behavior public (Axelrod, 1984;Dijkstra and Assen, 2013a; Granovetter, 1985, Granovetter, 1973; Macy and Skvoretz, 1998; Raub and Weesie, 1990; Tomochi, 2004).

Typically, in these analyses third actors 'embed' the cooperating dyad and support their cooperation relating information on the cooperators. The literature has focused on distinguishing closed triads in which three actors are connected (A - B - C - A), from open triads (A - B - C). Cooperation evolves more easily in these closed triads, because information on the likely behavior of actors circulates and because sanctioning is cheaper in triads.

This paper argues that third actors have an additional function, namely establishing local hierarchies, incentivizing actors to cooperate by connecting to a higher-standing actor. Prestige may be important to stimulate cooperation (Aerne, 2020; Clark and Wilson, 1961; Dijkstra and Assen, 2013a; Knoke, 1988;Puffer and Meindl, 1992). From the literature we know that open triads are not conducive to cooperation. This paper considers how these triads are closed in a directed network in order to shed light on the underlying rationales for triadic closure in cooperation. Given an open triad in a directed network (A $\rightarrow$ B $\rightarrow$ C), either A (A $\rightarrow$ B $\rightarrow$ C $\leftarrow$ A) or C can decide to close the triad (A $\rightarrow$ B $\rightarrow$ C $\rightarrow$ A). C might extend a link to A because it learns that A is a reliable cooperator from B, whose cooperation C enjoys. C is thus re-assured to cooperate with A. Moreover, if C values reciprocity, it may also recognize that A cooperates, but so far is not cooperated with and thus decide to balance out the benefits. This cyclic constellation in a closed triad would thus reflects the classical embeddedness argument.

In contrast, it might also be that A, in seeing that B extends a link to C, wishes to connect to

C. B indicates C as a desirable connection if B extends a link to C. In this constellation, A sends two ties, C receives two ties, and B sends and receives a tie. This situation therefore depicts a local hierarchy. While a motive such as prestige may trigger A to link to C, it is unlikely that the embeddedness argument applies: C is not cooperating so far, and thus, should be avoided by A. In contrast, if A cares about connecting to higher-standing actors, it might relate to C.

Empirically, the paper analyses how employers cooperate in networks based on exponential random graph models. It analyzes eight networks in two different sectors in which employers share information on prospective candidates. Sharing information on prospective candidates is an important form of cooperation among employers, given that they compete on the same labor markets (Gërxhani, Brandts, and Schram, 2013).

Employer referral networks present a case of cooperation that allows understanding how cooperation can be achieved in competitive situations. Other instances where employer cooperation matters and to which our analysis may extend include collective training (Culpepper, 2000; Culpepper, 2003), active labor market policy (Martin and Swank, 2004), building an occupational labor market to protect wages (Trampusch, 2020), and classical interest-based lobbying (Olson, 1965).

This paper contributes to the literature by closely analyzing the role of third actors in cooperation. It argues that cooperation needs to be examined beyond the dyad and undirected networks. Looking at directed, whole networks allows to shift from the question: are actors able to cooperate (as compared to not cooperate), towards the question: who are they cooperating with?

The remainder of the paper is structured as follows. First, it traces the literature on the role of triads in cooperation. In a second section it presents the case (referral networks) and argues that employer referral networks are a form of cooperation dilemma. Subsequently, it presents the data and the estimation method. This is followed by the results section. A fifth section discusses the results and concludes.

2 Literature: Cooperation in Networks

Third parties are important in dyadic cooperation for two reasons: (1) providing warranted information on other parties, (2) help sanction non-cooperators. This paper argues that they are also important in (3) inducing cooperation by incentivizing actors to cooperate with the next higher party.

The most prominent reason why third actors stimulate cooperation is that a third party may provide warranted information on actor behavior. The literature has focused on distinguishing closed triads in which three actors are connected (A - B - C - A), from open triads (A - B - C) in undirected networks. Cooperation between two actors is facilitated by the presence of a third party. Linking two actors previously indirectly connected through a third party (triadic closure) is central in order to mitigate uncertainty (Coleman, 1988). Such third actors take on the role of grantors, that allow "rolling over of expectations" from one actor to the other via this third party, reducing the insecurity one is exposed to when entering a cooperative relationship (Uzzi, 1997). Actors rely on their trusted partner's experience with a third party when taking cooperation decisions (Raub and Weesie, 1990, p. 631). Knowing that others are reliable partners is important when selecting whom to cooperate with (Dijkstra and Assen, 2013b; Granovetter, 1985; Macy and Skvoretz, 1998; Raub and Weesie, 1990; Tomochi, 2004). Unsurprisingly, the degree of cooperation depends on the share of connections in the network that are randomized (Tomochi, 2004, p. 320). In addition, sanctioning is cheaper in triads, because the costs for sanctioning an uncooperative counterpart can be divided between two cooperators (Coleman, 1988). Thus, third actors are important in that they transfer information on other actor's cooperativeness.

From the literature we know that open triads are not conducive to cooperation. Given an open triad (A $\rightarrow$ B $\rightarrow$ C), either A (A $\rightarrow$ B $\rightarrow$ C $\leftarrow$ A) or C can decide to close the triad (A $\rightarrow$ B $\rightarrow$ C $\rightarrow$ A). C might extend a link to A, because it sees that A is a reliable cooperator to B, whose cooperation C enjoys. This would reflect the classical embeddedness argument. Moreover, if C values reciprocity, it may also recognize that A cooperates, but so far is not cooperated with and thus decide to balance out the benefits.

In contrast, it might also be that A, in seeing that B extends a link to C, wishes to connect to C. In a directed network, if B extends a link to C, B indicates C as a desirable connection. The prestige conferred when relating to more prestigious actors, may convince actors to cooperate (Clark and Wilson, 1961, p. 133; Knoke, 1988, p. 315; Puffer and Meindl, 1992, p. 428). Earlier contributions have also shown that cooperation is sensitive to whether actors know how central their counterparts are in the respective network (Dijkstra and Assen, 2013b, p. 580). While a motive such as prestige may trigger A to link to C, it is unlikely that the embeddedness argument applies: C is not contributing to the public good so far, and thus, should be avoided by A.

In markets, such prestige of an organization may in certain contexts be of value in itself, but is also connected to economic benefits (Podolny, 1993). Highly prestigious organizations have lower advertising costs to convince consumers of the quality of their products, and lower costs for finance because they are preferred by banks. In the labor market, employees may accept lower salaries to work in a highly prestigious organization. Building up prestige with other, external partners is therefore a prominent motive for relating to and cooperating with others (Lazega and Pattison, 1999; Podolny, 1993, p. 63/64; Raub and Weesie, 1990). Ties to other employers are thus one of channels through which prestige is related, and transferring people from one organization to another is a common conduit of status (Podolny, 1993). In the case of referral networks, one would expect lower-status firms to provide trustworthy information particularly to higher status firms, because such a service would allow them to gain prestige.

3 Case: Referral networks as cooperation networks

The purpose attributed to referral networks is usually described as providing information on candidates that is not otherwise available. Employers ask other employers about candidates because they are exposed to an information asymmetry when hiring. When hiring, it is difficult for employers to assess the abilities and work ethics of candidates, because potential workers have little incentive to reveal their true characteristics (Autor, 2008; Rees, 1966; Stigler, 1962). One way of learning about candidates despite these information asymmetries is through common acquaintances referring candidates and providing trustworthy information. Employers are an important source of such informal information (Saloner, 1985). It is for instance common to rely on reference letters when hiring (Abel, Burger, and Piraino, 2017).

Referrers provide employers with hard-to-observe information about candidates (e.g. regarding soft skills) while providing candidates with realistic information about the job and the organizations. This ensures a better fit of candidate and job (Bills, Stasio, and Gërxhani, 2017; Marsden and Gorman, 2001, p. 481; Montgomery, 1991; Russo et al., 2000). Better matches switch less, and thus, informal hiring may also result in lower turnover subsequently (Marsden and Gorman, 2001, p. 481; Russo et al., 2000). Referred candidates already passed a screen, tend to be better suited for the job and also may have more realistic job expectations (Bills, Stasio, and Gërxhani, 2017; Fernandez, Castilla, and Moore, 2000; Marsden and Gorman, 2001). Gains from informal hiring should be particularly high, when errors are costly (Marsden and Gorman, 2001, p. 481).

As referral networks circulate critical information about candidates, forming such referral networks poses a cooperation problem to employers (Gërxhani, Brandts, and Schram, 2013). After all, employers are potential competitors. How does an employer know she can trust a reference? A competitor may wish to get rid of employees that do not perform well, or may not want well-performing employees to switch employers. Building a referral network is a classical cooperation dilemma: All employers would be better off if referrals would convey trustworthy information so as to make sure non-performing employees are excluded from the labor market. However, every individual employer has a strong incentive not to contribute to the public good and to refer good candidates, and perhaps even, to refer bad candidates.

Previous studies have focused on the role of a firm's current employees recommending candidates rather than on the role of other employers (Fernandez, Castilla, and Moore, 2000; Schram, Brandts, and Gërxhani, 2010). Referral networks among employers have received only scant attention so far (Bills, Stasio, and Gërxhani, 2017; Marsden and Gorman, 2001). This is surprising given the prevalent role references play in most labor markets. One exception is the seminal study by Gërxhani et al. based on experimental data. They show how the cost of ties affects how employers network forms (Gërxhani, Brandts, and Schram, 2013).

4 Data and Operationalization

In 2021, I conducted an employer survey in the Swiss fiduciary sector and the childcare sector in the French-speaking canton of Vaud (Switzerland). Exploiting the fact that both sectors are organized in associations and employers know each other, I asked from which of their colleagues they value a reference on a prospective employee.

4.1 Fiduciary sector

In the fiduciary sector, the national association is organized into regional sub-sections. Employers tend to know each other in these sub-sections, because they need to attend a certain number of further education seminars to maintain their membership, i.e. on the most recent developments in tax law. I gathered network data on four regional (cantonal) sections of the national association of fiduciaries: Geneva, Basel-City, Fribourg and Neuchâtel-Jura. These sections were selected because they were of a relatively small size with maximally 150 fiduciary businesses. This ensured that checking which of the the other fiduciaries they trusted in the section was manageable for survey participants.

The exact wording of the survey question was the following: “We would like to ask of which other employers you value a reference particularly. From which of these fiduciary businesses do you regard a reference as particularly telling? Please select all fiduciary businesses from the below list, of which you value a reference. Multiple answers are possible.”

I sent out the survey link via email on September 21, 2022, followed by a reminder on October 6. 2022. These email addresses pertained to the directors of the organizations. I then followed up with individual phone calls to ensure I had an adequate response rate to have a more or less complete picture of all four networks (response rate of 0.69 for Geneva (92/134 organizations); response rate of 0.64 for Basel (96/149 organizations); a response rate of 0.60 for Fribourg (34/57 organizations), and a response rate of 0.65 for Neuchâtel / Jura (34/ 52 organizations).

The graph shows the referral network of fiduciaries in Geneva. The nodes represent an organization, whereas an arrow indicates that the sender values a reference from the receiver. The color of the nodes represents whether or not the organization is member of a prestigious profes-

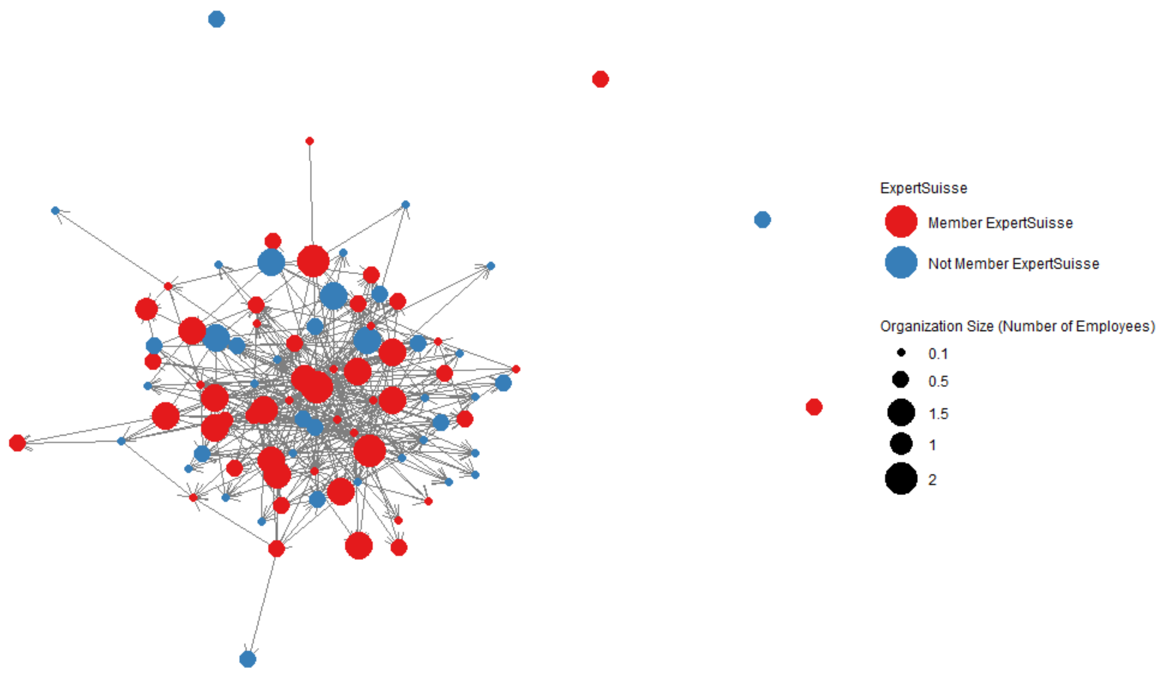

Figure 1: Network plot for the network of Geneva fiduciaries

sional association (ExpertSuisse), and the size of the nodes reflects the size of the organizations.

The list of organizations included information on whether the membership with Treuhand|Suisse is a personal one, or a corporate membership. This allowed checking if the organizations that didn't answer the survey are missing at random (MAR) or not. The association between 'missing' and the type of membership is insignificant in two of the four networks, Geneva and Neuchâtel-Jura (Chi-Squared test doesn't reach a significance of 0.05).

4.2 Childcare sector

In the childcare sector, I worked with the the association in the French-speaking canton of Vaud. The administrative unit responsible for overseeing childcare facilities (OAJE) provided us with a list of all licensed day-care centres in the canton of Vaud (605 unique email addresses of 743 day-care centres). The email address was that of the director of the centre. Again, these 743 organizations are split into local networks. Employers tend to know each other in these sub-sections, because they need to coordinate in various matters to get funding. I gathered network data on all local sections of the cantonal association except the one for Lausanne. The Lausanne network included over 200 organizations and it was deemed too daunting for employers to go

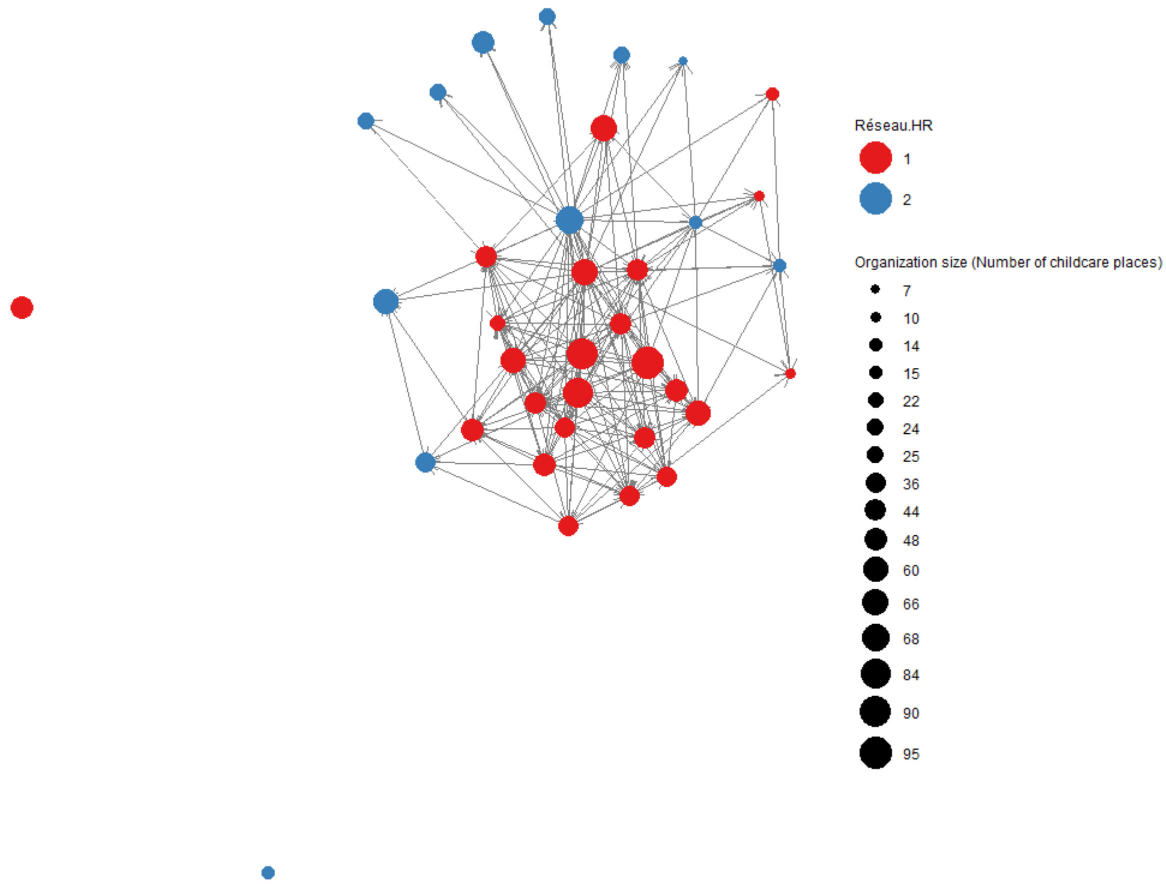

Figure 2: Network plot for the network of childcare centers in the newtork AJEMA

through a list of more than 200 organizations to check whose referrals they valued. In this paper I only analyse the four largest ones, due to constraints of time and space.

I sent out the first email inviting respondents to answer our survey on November 16, 2021 and followed up with four reminders. In total I received 359 completed surveys. The response rates in our four networks were 21 out of 29 for Enfants Chablais (0.72), 30 out of 49 for EFAJE (0.61), 36 out of 64 for AJEMA (0.56), and 21 out of 42 for RAT (0.50).

Below we see a network with all the childcare centers in the network called 'AJEMA'. The nodes represent organizations and an arrow indicates that a sender values the receiver regarding a reference. The color of the nodes indicates whether (red) or not (blue) an organization is part of a local network and receives public subsidies. The size of the nodes reflects the size of the organizations.

The list of organizations included information on the number of childcare places (Capacité Totale), organization type (Type), Location (Localité), legal form (Forme Juridique), whether an organization is part of a network (Réseau) and opening hours (Libellée Plage Ouverture). This allows checking if the organizations that didn't answer the survey differ from those that did. Checking the association between 'missing' and the variables I have for all the organizations with a Chi-Squared test shows no significant relationship (association does not reach a significance of 0.05) for any of the variables in any of the networks. The only exception is the the variable 'opening hours': there is a significant relationship between opening only on mornings and not having answered the survey.

4.3 Operationalization

Hierarchical closure is modelled with an edgewise shared partner term (gwesp). This term captures the tendency of connected dyads to share a third partner. The term is geometrically weighted discounting every additional shared partner at a constant factor (A $\rightarrow$ B $\rightarrow$ C $\leftarrow$ A). If triadic closure in cooperative settings is about building local hierarchies, I would expect this term to be positively significant. In the fiduciary sector, I include a measure on the prestige of organizations to better understand hierarchical processes in network formation. In particular, I use membership in a prestigious association (ExpertSuisse) as an indication of prestige among organizations. I would expect that prestigious organizations are better connected, that is, that they are more trusted referrers, but also that they have a more trustworthy network.

Embeddedness is modelled with a 3-cycle. This term captures that three actors are related in cycle (A $\rightarrow$ B $\rightarrow$ C $\rightarrow$ A). I also include a term for dyadic reciprocity (mutual) (A $\leftrightarrow$ B). If triadic closure in cooperative settings is about relating information on cooperators, I would expect this term to be positive.

I include a term controlling for open triads with a dyad-wise shared partner term (gwdsp). This term captures the tendency of unconnected dyads to share a third partner. Again, I include the term as a geometrically weighted term, discouningt every additional shared partner at a constant factor (A $\rightarrow$ B $\rightarrow$ C). I would expect this term to be negative in cooperative settings, because previous research indicates that cooperation evolves better if triads are closed.

I also control for the most prominent alternative explanations for the emergence of cooperation in competitive settings as highlighted in the literature. A first prominent argument is that organizations cooperate in order to access resources (Borgatti and Foster, 2003, p. 997; Gulati and Gargiulo, 2000, p.1; Mizruchi, 1993, p. 47; Oliver and Ebers, 1998, p. 575; Pfeffer, 1987). I use the number of employees as an indication of an organization's size to proxy its access to resources. I would expect larger organizations to be better connected, that is, that they are more trusted referrers, and also that they have a more trustworthy network.

A second prominent alternative explanation is homophily: actors rather cooperate with similar actors, than dissimilar actors. People are more likely to have relations of trust with people of the same ethnicity and of shared religion (Marsden, 1988; McPherson, Smith-Lovin, and Cook, 2001). Homophily as an antecedent is however not as prominent in the literature on inter-organizational cooperation. This is little surprising, as similarity among organizations fits squarely with the argument that organizations cooperate because they need to secure assets they lack; similarity and resource complementarity are somewhat opposing concepts. Nonetheless, similarity of beliefs and attitudes also matters in inter-organizational cooperation (Borgatti and Foster, 2003, p.997), as does goal congruence (Oliver and Ebers, 1998, p. 565). I conceptualized homophily as offering the same services in the fiduciary sector, and in the childcare sector as the type of organization (private or public).

I include various additional control variables, at the level of the organization (hiring difficulty, investment in training) and at the level of the respondent (role in the company, hiring experience, influence on hiring decisions, age, gender, education at secondary and tertiary level and nationality). I included these variables as node covariates (numeric variables), node factors (categorical variables), or edge-covariates (shared characteristics of nodes). A summary of the covariate data for all networks can be found in the annex.

Moroever, I included additional endogenous control variables, capturing relevant network processes so as to increase the model fit. I control for popularity, meaning the tendency of well-connected nodes to become even more connected (gwidegree), and I control for the general level of activity of nodes (gwodegree). I equally control for higher-level clustering with a cycle 4.

5 Estimation

The networks are modeled with exponential random graph models (ergms). In contrast to other approaches, ergms allow including network statistics, capturing network dynamics such as the tendency for generalized reciprocity or transitivity, as independent variables. Network formation is thus predicted based on endogenous network dynamics as well as exogenous factors such as individual and shared actor characteristics. The interpretation of the ergm corresponds to the interpretation of a logistic regression model of the formation of ties, where some of the independent variables represent statistics on structures incorporating other ties in the network.

The probability of observing a particular network is given by the following probability density function, where N specifies the network, and the coefficients to be modeled:

$$P(N,\theta) = \frac{exp\{\theta^T h(N)\}}{\sum_{N^* \varepsilon N} exp\{\theta^T h(N^*)\}}$$

P(N, θ) denotes the probability to observe this particular network. h(N) are the network statistics specified by the researcher. They may include endogenous (e.g. edgewise shared partners), as well as exogenous characteristics (e.g. number of employees). θ is a vector of the estimated coefficients. The symbol T indicates that a transpose is taken. The numerator, exp$\{\theta^T h(N)\}$, is the exponentiated sum of the weighted statistics of the observed network (i.e., the one to be modeled). The denominator $\sum_{N^* \varepsilon N} exp\{\theta^T h(N^*)\}$ sums these exponentiated sums of weighted statistics over all the possible topologies in the network. Thus, the whole expression is the probability of observing this particular network depending on the statistics included and given all the other possible networks that might have been observed. This expression is problematic for estimation because the set of all possible permutations of the network with the same number of nodes is very large, even for small networks.

Therefore, approaches to estimate network models rely on simulation. To determine parameter size, artificial networks were first sampled. Simulating new networks given the selected parameters is referred to as network sampling. Network sampling can be performed based on different sampling procedures (i.e., Markov Chain Monte Carlo (MCMC) sampling procedure based on Metropolis-Hastings algorithm). Next, the sampled networks, which are as close as possible to that empirically observed, were identified. For any sampled network, closeness to the observed network was therefore evaluated by comparing its sampling statistics to those of the observed network. The difference between the empirically observed network and the sampled ones was minimized by sampling over and over again and by accepting the parameter configuration yielding the most accurate networks (i.e. maximum likelihood (MLE)). This procedure is called MCMC-MLE and is commonly used to estimate ergms.

The ergm models presented here are based on MCMC network sampling and on MLE estimation. Figures in the annex show how the actually observed networks (black line) compare to the networks drawn from the ergm (confidence intervals) across different network statistics and that the fit is satisfactory for all eight networks.

6 Results

The endogenous network dynamics characterizing the networks are similar. The tendency for triads to remain open captured with a gwdsp term is negatively significant in all eight networks, except for the Basel network where it is not significant. This is in line with much of the literature that argues that triadic closure is key in maintaining cooperation.

The main finding is that there is a tendency towards hierarchic triadic closure. Hierarchic triadic closure as indicated by a positive and significant edgewise-shared partner term (gwesp) plays a role in all four fiduciary networks (Geneva, Basel and Neuchâtel-Jura and Fribourg) and in two out of four childcare networks (EFAJE, AJEMA). It is positive but statistically not significant in the other two childcare networks (RAT, Enfants Chablais).

There is no tendency towards horizontal triadic closure. The term three-cycle is not significant in any of the fiduciary nor the childcare networks, with the exception of the AJEMA network, where it is positively significant at the 5% level. In addition, dyadic reciprocity captured with the term mutual is not significant in five out of eight networks (Fribourg, Neuchâtel-Jura, EFAJE, RAT, Enfants Chablais), and only positively significant at the 5 % in the other three networks (Basel, Geneva, AJEMA).

There is a clear tendency towards hierarchical, rather than horizontal triadic closure. Earlier, it was suggested that this form of triadic closure might reflect a desire of actors to connect to

	Basel	Fribourg	Geneva	Neuchâtel-Jura
edges	5.26	−1.94	4.66	60.41^{**}
	(8.85)	(16.52)	(8.24)	(22.51)
nodecov.NumEmp	0.01^{*}	−0.00	−0.01	0.02
	(0.00)	(0.01)	(0.01)	(0.01)
nodefactor.ExpSuisse.1	0.15^{**}	0.34^{*}	0.36^{***}	0.12
	(0.05)	(0.15)	(0.10)	(0.14)
nodecov.Hiring_Difficult	0.01^{*}	−0.00	0.00	-0.03^{**}
	(0.00)	(0.01)	(0.01)	(0.01)
nodefactor.Trainingfirm.1	0.11^{**}	0.13	0.10	−0.17
	(0.04)	(0.12)	(0.06)	(0.11)
nodefactor.Role.2	0.09	0.26	−0.22	−0.42
	(0.10)	(0.24)	(0.12)	(0.23)
nodefactor.Role.3	0.23^{*}	0.04	0.13	-0.71^{*}
	(0.11)	(0.31)	(0.12)	(0.30)
nodefactor.Role.4	0.25^{*}	−0.21	0.21	-0.65^{*}
	(0.10)	(0.31)	(0.11)	(0.31)
nodecov.Influence_Hiring	−0.01	0.27^{*}	-0.16^{**}	−0.01
	(0.03)	(0.12)	(0.05)	(0.09)
nodecov.Experience_Hiring	−0.02	0.03	0.03^{**}	0.00
	(0.01)	(0.03)	(0.01)	(0.03)
nodecov.Age	−0.00	−0.00	−0.00	-0.02^{**}
	(0.00)	(0.00)	(0.00)	(0.01)
nodefactor.Gender.2	−0.01	0.07	−0.04	0.54^{*}
	(0.08)	(0.11)	(0.08)	(0.27)
edgecov.Shared_Services	0.01	0.02	0.05^{***}	0.04
	(0.02)	(0.03)	(0.01)	(0.03)
edgecov.Shared_Education	0.02	−0.25	0.20	0.22
	(0.07)	(0.14)	(0.13)	(0.21)
edgecov.Shared_Nationality	0.21	0.66	0.12	0.02
	(0.13)	(0.35)	(0.10)	(0.35)
edgecov.Shared_Gender	−0.11	−0.25	0.05	−0.24
	(0.14)	(0.21)	(0.12)	(0.30)
reciprocity (mutual)	0.57^{*}	−0.16	0.68^{*}	−0.28
	(0.26)	(0.36)	(0.34)	(0.39)
hierarchically closed triads (gwesp)	1.38^{***}	0.71^{**}	0.99^{***}	1.08^{***}
	(0.08)	(0.25)	(0.10)	(0.25)
open triads (gwdsp)	0.00	-0.29^{***}	-0.16^{***}	-0.24^{***}
	(0.01)	(0.04)	(0.02)	(0.04)
popularity (gwideg)	2.24^{***}	3.03	−0.40	0.41
	(0.66)	(3.42)	(0.37)	(0.81)
activity (gwodeg)	-2.07^{***}	-4.25^{***}	-3.42^{***}	-1.72^{**}
	(0.34)	(0.93)	(0.36)	(0.66)
horizontally closed triads (cycle3)	−0.23	0.20	−0.19	0.18
	(0.18)	(0.21)	(0.27)	(0.25)
cycle4	-0.12^{***}	−0.04	−0.02	−0.06
	(0.03)	(0.04)	(0.07)	(0.05)
AIC	2962.49	863.03	2529.22	863.44
BIC	3133.32	983.58	2698.00	983.99
Log Likelihood	−1457.24	−407.52	−1240.61	−407.72

$^{***}p < 0.001$; $^{**}p < 0.01$; $^{*}p < 0.05$

Table 1: Results for the exponential random graph models for the four fiduciary networks. Estimation with MCMC-MLE.

	EFAJE	AJEMA	RAT	ENFANT
edges	-1.59	-3.68^{***}	-3.09	1.44
	(0.85)	(0.83)	(2.26)	(2.23)
nodefactor.Réseau.HR.2	-0.27	0.01	0.23	-0.20
	(0.40)	(0.15)	(0.33)	(0.57)
nodecov.Years_worked	-0.02	-0.00	0.03	-0.00
	(0.01)	(0.01)	(0.02)	(0.02)
nodefactor.Gender.2	0.07	-0.21	-0.79	0.99^{*}
	(0.17)	(0.18)	(0.54)	(0.40)
nodefactor.Role.3	-0.29	0.23	0.73^{*}	-0.07
	(0.18)	(0.21)	(0.36)	(0.48)
nodefactor.apprentices...yes_no.2	0.07	0.17	0.64	-0.62
	(0.12)	(0.15)	(0.36)	(0.34)
nodefactor.apprentices...yes_no.3		0.16	-0.89	
		(0.22)	(1.13)	
nodecov.Influence_hiring	-0.06	0.05	-0.22	-0.43^{**}
	(0.05)	(0.05)	(0.22)	(0.14)
nodecov.Num_Hirings_done	0.00	0.01	0.04^{*}	0.01
	(0.01)	(0.01)	(0.01)	(0.01)
nodecov.Hiring_Difficult	0.00	0.03	0.16	0.07
	(0.04)	(0.05)	(0.17)	(0.17)
nodecov.Capacité.totale	0.00	0.01^{**}	-0.00	0.02^{*}
	(0.00)	(0.00)	(0.00)	(0.01)
edgecov.Shared_Structures_Type	0.25	0.05	0.39	0.23
	(0.14)	(0.17)	(0.28)	(0.34)
edgecov.Shared_Nationality	0.21	0.05	-1.30^{*}	-0.40
	(0.22)	(0.16)	(0.53)	(0.63)
edgecov.Shared_Réseau.HR	0.09	0.45^{*}	0.52	0.46
	(0.40)	(0.18)	(0.26)	(0.56)
reciprocity (mutual)	0.08	0.77^{*}	0.04	0.58
	(0.48)	(0.32)	(0.51)	(0.43)
hierarchically closed triads (gwdsp)	-0.25^{***}	-0.29^{***}	-0.29^{**}	-0.29^{**}
	(0.04)	(0.03)	(0.09)	(0.09)
open triads (gwesp)	0.85^{***}	1.08^{***}	0.39	0.51
	(0.14)	(0.27)	(0.31)	(0.50)
popularity (gwideg)	1.47	0.36	9.97^{*}	-0.07
	(0.81)	(0.64)	(5.05)	(1.29)
activity (gwodeg)	-1.00	-2.55^{***}	0.94	-0.27
	(0.67)	(0.68)	(1.04)	(1.35)
horizontally closed triads (cycle3)	0.47	0.44^{*}	0.21	0.38
	(0.27)	(0.18)	(0.38)	(0.26)
cycle4	-0.07	-0.05	-0.13	-0.12^{**}
	(0.04)	(0.03)	(0.12)	(0.04)
AIC	561.04	886.73	392.76	398.89
BIC	656.41	994.64	477.61	475.59
Log Likelihood	-260.52	-422.36	-175.38	-179.45

$^{***}p < 0.001$; $^{**}p < 0.01$; $^{*}p < 0.05$

Table 2: Results for the exponential random graph models for the four childcare networks. Estimation with MCMC-MLE.

a higher standing actor. In contrast, cyclic triads might reflect the availability of information about an actor's cooperative behavior. In line with this reading is the fact that prestige in the fiduciary sector also has a positive and significant effect on being connected in three out of the four networks (Basel, Fribourg, Geneva). Unfortunatley, we lack a comparable measure for prestige in the childcare sector.

We analyze the role of prestige further to better understand how it influences network formation. First, we analyzed if prestigious actors are also more likely to be in a transitive triad. Thus, we extracted the neighborhood of all nodes in a network, and counted the number of transitive triads nodes were part of. We normalized the number of transitive triads first with the total number of connected triads (cyclic and transitive). We find a correlation of 0.206272, statistically significant with a p-level of 0.002006 between prestige and the share of transitive compared to the total number of connected triads, based on spearman's rank correlation rho.

Second, we normalize the number of transitive triads with the number of open triads, with two ties present. We find that a correlation of 0.190142 significant with a p-level of 0.004469 between prestige and the share of transitively closed triads compared to non-closed triads.

Together, these results suggest that prestigious organizations are more likely to be in a hierarchically rather than horizontally closed triad, compared to non-prestigious organizations. Moreover, the second result suggests that prestigious organizations are more likely to be in a hierarchically closed triad, compared to staying in an open triad, than less prestigious organizations.

7 Discussion

We find that triads exhibit a tendency towards hierarchic closure (gwesp) in employer referral networks. In contrast, we do not find any evidence for horizontal closure in employer referral networks. This finding in line with the literature arguing that third actors play an important role in securing cooperation between any two actors. However, much of the literature argues that third actors are important because they transmit information on non-cooperators and share in sanctioning costs, suggesting a cyclic, horizontal connection in triads. However, we find that triads are structured in a hierarchical, rather than a horizontal manner. Further analzying the role of prestige in these triads shows that prestigious organizations are more likely to be in hierarchical, rather than horizontally connected triads. Moreover, we find that prestigious organizations are more likely to be in hierarchically connected than open triads. This suggests that an additional rationale, relevant in cooperation is that actors cooperate in order to connect to more prestigious actors.

WE think that these results might generalize to other instances of cooperation. Employer referral networks are a fairly general instance of employer cooperation, and it is likely that similar dynamics characterize other employer cooperation networks. Moreover, the two sectors analyzed (childcare and fiduciary) are fairly different. We therefore think that prestige and hierarchical closure are a feature characterizing cooperation beyond the case we look at.

8 Conclusion

Cooperative networks are characterized by hierarchic triadic closure, rather than reciprocity. This means that cooperation in larger contexts is achieved by building localized hierarchies. This contrasts with the literature analyzing dyadic cooperation, emphasizing reciprocity as an important dynamic to achieve cooperation.

Based on our results, it is likely that the role of third parties extends beyond providing truthful information on potential cooperators. Information on non-cooperators can be circulated in cyclic and hierarchic triads equally. However, building prestige is more easily achieved in hierarchic triads. These results thus suggest that the role of 'embeddedness' and contextual factors in cooperation should be re-evaluated.

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Appendix: Supplementary Material

8.1 Descriptive Statistics Covariate Data Fiduciary Networks

Table A.1: Covariate Data Fiduciary Network Basel

	variable	Median	Mean	SD	SE	Min	Max	q25	q75	n	Missing
1	FrequencyHiring	3.00	3.26	3.13	0.32	0.00	20.00	1.00	5.00	96	5
2	NumberEmployeesTot	6.00	7.72	6.01	0.61	0.00	24.00	3.00	11.00	96	21
3	CurrentRole	3.00	2.88	1.01	0.10	1.00	4.00	2.25	4.00	96	2
4	NumServicesProvided	9.00	7.15	4.32	0.44	0.00	14.00	4.00	10.00	96	0
5	InfluenceHiring	3.00	3.13	1.05	0.11	1.00	4.00	3.00	4.00	96	4
6	DifficultHiring	11.00	10.82	5.87	0.60	0.00	20.00	6.00	16.00	96	11
7	App	0.00	0.27	0.45	0.05	0.00	1.00	0.00	1.00	96	21
8	Age	1971.00	1970.46	10.71	1.09	1945.00	2000.00	1962.00	1977.00	96	25
9	Nationality	1.00	2.70	5.51	0.56	1.00	22.00	1.00	1.00	96	25
10	MemberExpertSuisse	0.00	0.44	0.50	0.05	0.00	1.00	0.00	1.00	96	21
11	EducationSecondary	2.00	1.24	1.07	0.11	0.00	3.00	0.00	2.00	96	0
12	EducationTertiary	1.00	1.06	1.34	0.14	0.00	6.00	0.00	2.00	96	0

Table 2: Covariate Data Fiduciary Network Fribourg

	variable	Median	Mean	SD	SE	Min	Max	q25	q75	n	Missing
1	FrequencyHiring	3.00	4.00	3.48	0.60	0.00	15.00	2.00	5.00	34	3
2	NumberEmployeesTot	4.00	7.33	7.02	1.20	1.00	25.00	3.00	9.00	34	7
3	CurrentRole	3.00	2.88	0.83	0.14	1.00	4.00	2.00	3.00	34	2
4	NumServicesProvided	9.50	7.71	4.43	0.76	0.00	13.00	7.25	10.75	34	0
5	InfluenceHiring	3.00	3.09	0.89	0.15	1.00	4.00	2.00	4.00	34	2
6	DifficultHiring	5.00	6.93	6.10	1.05	0.00	19.00	2.00	12.00	34	5
7	App	0.00	0.44	0.51	0.09	0.00	1.00	0.00	1.00	34	7
8	Age	1974.00	1976.52	12.32	2.11	1959.00	2001.00	1967.50	1985.50	34	7
9	Nationality	1.00	1.78	4.04	0.69	1.00	22.00	1.00	1.00	34	7
10	MemberExpertSuisse	1.00	0.59	0.50	0.09	0.00	1.00	0.00	1.00	34	7
11	EducationSecondary	0.00	1.00	1.13	0.19	0.00	3.00	0.00	2.00	34	0
12	EducationTertiary	1.00	1.32	1.55	0.27	0.00	6.00	0.00	2.00	34	0

Table 3: Covariate Data Fiduciary Network Geneva

	variable	Median	Mean	SD	SE	Min	Max	q25	q75	n	Missing
1	FrequencyHiring	2.00	3.45	3.87	0.40	0.00	20.00	1.00	5.00	92	7
2	NumberEmployeesTot	6.00	7.53	6.70	0.70	1.00	38.00	3.00	10.00	92	13
3	CurrentRole	3.00	2.93	0.88	0.09	1.00	4.00	2.75	4.00	92	8
4	NumServicesProvided	10.00	8.77	3.70	0.39	0.00	14.00	8.00	11.00	92	0
5	InfluenceHiring	3.00	3.09	0.71	0.07	1.00	4.00	3.00	4.00	92	6
6	DifficultHiring	5.00	6.79	5.37	0.56	0.00	18.00	2.00	11.00	92	10
7	App	0.50	0.50	0.50	0.05	0.00	1.00	0.00	1.00	92	10
8	Age	1972.00	1973.48	14.48	1.51	1941.00	2003.00	1963.00	1982.75	92	10
9	Nationality	1.00	2.94	5.19	0.54	1.00	22.00	1.00	1.00	92	11
10	MemberExpertSuisse	1.00	0.55	0.50	0.05	0.00	1.00	0.00	1.00	92	10
11	EducationSecondary	0.00	0.73	1.04	0.11	0.00	3.00	0.00	2.00	92	0
12	EducationTertiary	1.00	1.27	1.71	0.18	0.00	6.00	0.00	2.00	92	0

Table 4: Covariate Data Fiduciary Network Neuchâtel Jura

	variable	Median	Mean	SD	SE	Min	Max	q25	q75	n	Missing
1	Years Worked	4.00	7.57	9.16	2.00	0.50	42.00	3.00	10.00	21	0
2	NumberHires	2.00	3.33	3.73	0.81	0.00	15.00	1.00	4.00	21	0
3	NumberEmployees	11.00	15.38	14.64	3.19	2.00	63.00	5.00	18.00	21	0
4	Role	3.00	2.71	0.46	0.10	2.00	3.00	2.00	3.00	21	0
5	StructuresType	2.00	2.76	0.89	0.19	2.00	4.00	2.00	4.00	21	0
6	InfluenceHiring	2.00	2.55	0.83	0.18	2.00	4.00	2.00	3.00	21	1
7	NumberHiringsDone	5.00	10.00	12.67	2.77	0.00	50.00	2.75	13.50	21	1
8	HiringDifficult	3.00	2.60	1.31	0.29	0.00	4.00	2.00	3.25	21	1
9	Trainingfirm	2.00	1.75	0.55	0.12	1.00	3.00	1.00	2.00	21	1
10	Gender	1.00	1.11	0.32	0.07	1.00	2.00	1.00	1.00	21	3
11	Year birth	1976.00	1977.44	8.26	1.80	1961.00	1994.00	1972.00	1982.75	21	3
12	Nationality	1.00	1.50	1.25	0.27	1.00	6.00	1.00	1.00	21	3
13	Capacité.totale	29.00	36.95	27.92	6.09	10.00	130.00	20.00	48.00	21	0
14	Fonction.directeur.structure	1.00	1.48	0.51	0.11	1.00	2.00	1.00	2.00	21	0
15	Localité	82.00	79.33	50.31	10.98	3.00	140.00	47.00	125.00	21	0
16	Réseau.HR	1.00	1.43	0.51	0.11	1.00	2.00	1.00	2.00	21	0
17	Type	1.00	1.62	0.74	0.16	1.00	3.00	1.00	2.00	21	0

Table 5: Covariate Data Fiduciary Networks Membership in Expert Suisse

	Member	Not Member	NA	Total
Basel Membership in ExpertSuisse N	33.00	42.00	21.00	96.00
Basel Membership in ExpertSuisse Share	0.34	0.44	0.22	1.00
Fribourg Membership in ExpertSuisse N	16.00	11.00	7.00	34.00
Fribourg Membership in ExpertSuisse Share	0.47	0.32	0.21	1.00
Geneva Membership in ExpertSuisse N	45.00	37.00	10.00	92.00
Geneva Membership in ExpertSuisse Share	0.49	0.40	0.11	1.00
Neuchâtel - Jura Membership in ExpertSuisse N	22.00	10.00	2.00	34.00
Neuchâtel - Jura Membership in ExpertSuisse Share	0.65	0.29	0.06	1.00

Table 6: Covariate Data Fiduciary Networks Training Firm

	Doesn't train	Training firm	NA	Total
Basel Trainingfirms N	55.00	20.00	21.00	96.00
Basel Trainingfirms Share	0.57	0.21	0.22	1.00
Fribourg Trainingfirms N	15.00	12.00	7.00	34.00
Fribourg Trainingfirms Share	0.44	0.35	0.21	1.00
Geneva Trainingfirms N	41.00	41.00	10.00	92.00
Geneva Trainingfirms Share	0.45	0.45	0.11	1.00
Neuchâtel Jura Trainingfirms N	20.00	12.00	2.00	34.00
Neuchâtel Jura Trainingfirms Share	0.59	0.35	0.06	1.00

Table 7: Covariate Data Fiduciary Networks Role Respondent

	Geschäftsführer.in	Mandatsleiter.in	Sachbearbeiter.in	Partner.in	NA.	Total
Basel Role N	42.00	9.00	15.00	28.00	2.00	96.00
Basel Role Share	0.44	0.09	0.16	0.29	0.02	1.00
Fribourg Role N	16.00	7.00	2.00	7.00	2.00	34.00
Fribourg Role Share	0.47	0.21	0.06	0.21	0.06	1.00
Geneva Role N	42.00	15.00	7.00	24.00	4.00	92.00
Geneva Role Share	0.46	0.16	0.08	0.26	0.04	1.00
Neuchâtel Jura Role N	16.00	6.00	4.00	8.00	0.00	34.00
Neuchâtel Jura Role Share	0.47	0.18	0.12	0.24	0.00	1.00

Table 8: Covariate Data Fiduciary Networks Secondary Education

	Basel N	Basel share	Fribourg N	Fribourg share	Geneva N	Geneva share	Neuchâtel-Jura N	Neuchâtel-Jura share
Gymnasium	7.00	0.07	2.00	0.06	2.00	0.02	1.00	0.03
Handelsschule	9.00	0.09	1.00	0.03	8.00	0.09	3.00	0.09
KV EFZ and. Aus.	21.00	0.22	2.00	0.06	2.00	0.02	1.00	0.03
KV EFZ and. Aus. mit BM	0.00	0.00	2.00	0.06	0.00	0.00	4.00	0.12
KV EFZ DL&A	6.00	0.06	2.00	0.06	6.00	0.07	3.00	0.09
KV EFZ DL&A mit BM	16.00	0.17	9.00	0.26	12.00	0.13	7.00	0.21
KV EFZ Treuhand	0.00	0.00	1.00	0.03	0.00	0.00	0.00	0.00
NA	30.00	0.31	9.00	0.26	26.00	0.28	5.00	0.15
Total	96.00	1.00	34.00	1.00	92.00	1.00	34.00	1.00

Table 9: Covariate Data Fiduciary Networks Tertiary Education

	Basel N	Basel share	Fribourg N	Fribourg share	Geneva N	Geneva share	Neuchâtel-Jura N	Neuchâtel-Jura share
BA Business UAS	4.00	0.04	4.00	0.12	3.00	0.03	3.00	0.09
BA Business Univ.	1.00	0.01	2.00	0.06	1.00	0.01	1.00	0.03
Berufsprüf. Treuhänder/in	30.00	0.31	11.00	0.32	13.00	0.14	10.00	0.29
Exp. Rechnungsl./Control.	9.00	0.09	3.00	0.09	3.00	0.03	3.00	0.09
Steuerexpert/in	1.00	0.01	0.00	0.00	3.00	0.03	1.00	0.03
Treuhandexpert/in	19.00	0.20	6.00	0.18	10.00	0.11	2.00	0.06
Wirtschaftsprüfer/in	8.00	0.08	1.00	0.03	16.00	0.17	2.00	0.06
MA Business Univ.	3.00	0.03	1.00	0.03	7.00	0.08	1.00	0.03
MA Business UAS	3.00	0.03	1.00	0.03	2.00	0.02	0.00	0.00
NA	30.00	0.31	9.00	0.26	26.00	0.28	5.00	0.15
Total	96.00	1.00	34.00	1.00	92.00	1.00	34.00	1.00

Table 10: Covariate Data Fiduciary Networks Services Provided

	Basel N	Basel share	Fribourg N	Fribourg share	Geneva N	Geneva share	Neuchâtel-Jura N	Neuchâtel-Jura share
Finanzbuchaltung	75.00	0.78	26.00	0.76	79.00	0.86	31.00	0.91
Domizilhaltung	48.00	0.50	22.00	0.65	75.00	0.82	24.00	0.71
Erbschaftsberatung	43.00	0.45	19.00	0.56	41.00	0.45	23.00	0.68
Gesellschaftsgründung	61.00	0.64	26.00	0.76	79.00	0.86	28.00	0.82
Liegenschaftsverwaltung	26.00	0.27	11.00	0.32	15.00	0.16	14.00	0.41
Lohnbuchhaltung	71.00	0.74	25.00	0.74	77.00	0.84	29.00	0.85
Organisationsberatung	33.00	0.34	16.00	0.47	51.00	0.55	16.00	0.47
Personaladministration	64.00	0.67	22.00	0.65	71.00	0.77	25.00	0.74
Rechtsberatung	25.00	0.26	6.00	0.18	43.00	0.47	11.00	0.32
Steuerberatung	74.00	0.77	26.00	0.76	77.00	0.84	32.00	0.94
Unternehmensberatung	64.00	0.67	26.00	0.76	76.00	0.83	32.00	0.94
Vermögensverwaltung	14.00	0.15	1.00	0.03	11.00	0.12	3.00	0.09
Wirtschaftsprüfung	47.00	0.49	19.00	0.56	42.00	0.46	24.00	0.71
Betriebl. Rechnungswesen	41.00	0.43	17.00	0.50	70.00	0.76	26.00	0.76
NA	21.00	0.22	7.00	0.21	10.00	0.11	2.00	0.06
Total	96.00	1.00	34.00	1.00	92.00	1.00	34.00	1.00

Table 11: Covariate Data Fiduciary Networks Nationality

	Basel N	Basel share	Fribourg N	Fribourg share	Geneva N	Geneva share	Neuchâtel-Jura N	Neuchâtel-Jura share
Switzerland	69.00	0.69	27.00	0.79	69.00	0.75	31.00	0.91
Italy	6.00	0.06	0.00	0.00	0.00	0.00	0.00	0.00
France	3.00	0.03	0.00	0.00	12.00	0.13	0.00	0.00
Germany	1.00	0.01	0.00	0.00	0.00	0.00	0.00	0.00
Spain	0.00	0.00	0.00	0.00	2.00	0.02	0.00	0.00
Portugal	1.00	0.01	1.00	0.03	2.00	0.02	0.00	0.00
Other	0.00	0.00	0.00	0.00	6.00	0.07	0.00	0.00
NA	25.00	0.25	7.00	0.21	10.00	0.11	3.00	0.09
Total	100.00	1.00	34.00	1.00	92.00	1.00	34.00	1.00

Table 12: Covariate Data Fiduciary Networks Gender

	Female	Male	Prefer not to answer	NA	Total
Basel Gender N	23.00	51.00	1.00	25.00	100.00
Basel Gender Share	0.23	0.51	0.01	0.25	1.00
Fribourg Gender N	10.00	17.00	0.00	7.00	34.00
Fribourg Gender Share	0.29	0.50	0.00	0.21	1.00
Geneva Gender N	27.00	54.00	1.00	10.00	92.00
Geneva Gender Share	0.29	0.59	0.01	0.11	1.00
Neuchâtel-Jura Gender N	6.00	24.00	1.00	3.00	34.00
Neuchâtel-Jura Gender Share	0.18	0.71	0.03	0.09	1.00

8.2 Descriptive Statistics Covariate Data Childcare

Table 13: Covariate Data Childcare Network AJEMA

	variable	Median	Mean	SD	SE	Min	Max	q25	q75	n	Missing
1	Years Worked	6.00	7.69	7.21	1.20	0.25	30.00	2.00	10.00	36	1
2	NumberHires	2.00	3.10	3.49	0.58	0.00	15.00	1.00	3.00	36	1
3	NumberEmployees	13.00	18.46	21.08	3.51	1.00	106.00	6.00	20.00	36	1
4	Role	3.00	2.89	0.32	0.05	2.00	3.00	3.00	3.00	36	1
5	StructuresType	2.00	2.74	0.89	0.15	2.00	4.00	2.00	4.00	36	1
6	InfluenceHiring	2.00	2.89	0.99	0.17	2.00	4.00	2.00	4.00	36	1
7	NumberHiringsDone	8.00	11.09	11.65	1.94	1.00	60.00	4.50	15.00	36	1
8	HiringDifficult	3.00	2.69	1.32	0.22	0.00	5.00	2.00	4.00	36	1
9	Trainingfirm	2.00	1.82	0.53	0.09	1.00	3.00	2.00	2.00	36	3
10	Gender	1.00	1.06	0.24	0.04	1.00	2.00	1.00	1.00	36	3
11	Year birth	1975.00	1975.85	8.80	1.47	1953.00	1991.00	1971.00	1983.00	36	3
12	Nationality	1.00	1.30	0.68	0.11	1.00	3.00	1.00	1.00	36	3
13	Capacité.totale	44.00	41.53	22.63	3.77	7.00	95.00	24.00	51.00	36	0
14	Fonction.directeur.structure	1.00	1.14	0.35	0.06	1.00	2.00	1.00	1.00	36	0
15	Localité	73.50	69.67	38.55	6.43	2.00	134.00	50.00	93.00	36	0
16	Réseau.HR	1.00	1.33	0.48	0.08	1.00	2.00	1.00	2.00	36	0
17	Type	2.00	1.78	0.72	0.12	1.00	3.00	1.00	2.00	36	0

Table 14: Covariate Data Childcare Network EFAJE

	variable	Median	Mean	SD	SE	Min	Max	q25	q75	n	Missing
1	Years Worked	4.50	5.67	4.21	0.77	0.50	17.00	2.25	8.00	30	0
2	NumberHires	2.00	1.87	1.31	0.24	0.00	5.00	1.00	3.00	30	0
3	NumberEmployees	7.50	10.00	7.75	1.42	1.00	28.00	5.00	14.00	30	0
4	Role	3.00	2.87	0.35	0.06	2.00	3.00	3.00	3.00	30	0
5	StructuresType	3.00	2.77	0.82	0.15	2.00	4.00	2.00	3.00	30	0
6	InfluenceHiring	4.00	3.13	0.97	0.18	2.00	4.00	2.00	4.00	30	0
7	NumberHiringsDone	5.00	6.67	5.63	1.03	0.00	22.00	2.25	10.00	30	0
8	HiringDifficult	3.00	2.37	1.47	0.27	0.00	5.00	2.00	3.00	30	0
9	Trainingfirm	2.00	1.62	0.49	0.09	1.00	2.00	1.00	2.00	30	1
10	Gender	1.00	1.11	0.31	0.06	1.00	2.00	1.00	1.00	30	2
11	Year birth	1975.50	1975.36	8.07	1.47	1956.00	1991.00	1970.75	1979.75	30	2
12	Nationality	1.00	1.64	1.91	0.35	1.00	10.00	1.00	1.00	30	2
13	Capacité.totale	36.00	41.83	27.38	5.00	10.00	120.00	17.75	60.00	30	0
14	Fonction.directeur.structure	1.00	1.07	0.25	0.05	1.00	2.00	1.00	1.00	30	0
15	Localité	80.00	72.87	37.44	6.83	11.00	144.00	49.00	94.25	30	0
16	Réseau.HR	1.00	1.23	0.43	0.08	1.00	2.00	1.00	1.00	30	0
17	Type	1.50	1.57	0.63	0.11	1.00	3.00	1.00	2.00	30	0

Table 15: Covariate Data Childcare Network Enfants Chablais

	variable	Median	Mean	SD	SE	Min	Max	q25	q75	n	Missing
1	Years Worked	10.00	8.62	6.37	1.46	0.00	21.00	2.50	13.00	19	0
2	NumberHires	2.00	2.37	2.34	0.54	0.00	10.00	1.50	2.00	19	0
3	NumberEmployees	11.00	14.16	14.42	3.31	2.00	63.00	5.00	13.50	19	0
4	Role	3.00	2.89	0.32	0.07	2.00	3.00	3.00	3.00	19	0
5	StructuresType	2.00	2.58	0.84	0.19	2.00	4.00	2.00	3.00	19	0
6	InfluenceHiring	4.00	3.11	0.99	0.23	2.00	4.00	2.00	4.00	19	0
7	NumberHiringsDone	5.00	8.00	10.59	2.43	1.00	50.00	4.00	8.50	19	0
8	HiringDifficult	3.00	2.89	0.81	0.19	1.00	4.00	2.50	3.00	19	0
9	Trainingfirm	2.00	1.79	0.42	0.10	1.00	2.00	2.00	2.00	19	0
10	Gender	1.00	1.16	0.37	0.09	1.00	2.00	1.00	1.00	19	0
11	Year birth	1976.00	1974.63	10.03	2.30	1958.00	1992.00	1966.00	1982.00	19	0
12	Nationality	1.00	1.68	2.11	0.48	1.00	9.00	1.00	1.00	19	0
13	Capacité.totale	36.00	36.84	22.65	5.20	7.00	83.00	20.50	48.00	19	0
14	Fonction.directeur.structure	1.00	1.00	0.00	0.00	1.00	1.00	1.00	1.00	19	0
15	Localité	96.00	90.16	49.63	11.39	1.00	145.00	73.00	137.00	19	0
16	Réseau.HR	1.00	1.16	0.37	0.09	1.00	2.00	1.00	1.00	19	0
17	Type	2.00	1.74	0.65	0.15	1.00	3.00	1.00	2.00	19	0

Table 16: Covariate Data Childcare Network RAT

	variable	Median	Mean	SD	SE	Min	Max	q25	q75	n	Missing
1	Years Worked	4.00	7.57	9.16	2.00	0.50	42.00	3.00	10.00	21	0
2	NumberHires	2.00	3.33	3.73	0.81	0.00	15.00	1.00	4.00	21	0
3	NumberEmployees	11.00	15.38	14.64	3.19	2.00	63.00	5.00	18.00	21	0
4	Role	3.00	2.71	0.46	0.10	2.00	3.00	2.00	3.00	21	0
5	StructuresType	2.00	2.76	0.89	0.19	2.00	4.00	2.00	4.00	21	0
6	InfluenceHiring	2.00	2.55	0.83	0.18	2.00	4.00	2.00	3.00	21	1
7	NumberHiringsDone	5.00	10.00	12.67	2.77	0.00	50.00	2.75	13.50	21	1
8	HiringDifficult	3.00	2.60	1.31	0.29	0.00	4.00	2.00	3.25	21	1
9	Trainingfirm	2.00	1.75	0.55	0.12	1.00	3.00	1.00	2.00	21	1
10	Gender	1.00	1.11	0.32	0.07	1.00	2.00	1.00	1.00	21	3
11	Year birth	1976.00	1977.44	8.26	1.80	1961.00	1994.00	1972.00	1982.75	21	3
12	Nationality	1.00	1.50	1.25	0.27	1.00	6.00	1.00	1.00	21	3
13	Capacité.totale	29.00	36.95	27.92	6.09	10.00	130.00	20.00	48.00	21	0
14	Fonction.directeur.structure	1.00	1.48	0.51	0.11	1.00	2.00	1.00	2.00	21	0
15	Localité	82.00	79.33	50.31	10.98	3.00	140.00	47.00	125.00	21	0
16	Réseau.HR	1.00	1.43	0.51	0.11	1.00	2.00	1.00	2.00	21	0
17	Type	1.00	1.62	0.74	0.16	1.00	3.00	1.00	2.00	21	0

Table 17: Covariate Data Childcare Networks Role

	Director	Other	NA	Total
AJEMA Role N	31.00	4.00	1.00	36.00
AJEMA Role Share	0.86	0.11	0.03	1.00
EFAJE Role N	26.00	4.00	0.00	30.00
EFAJE Role Share	0.87	0.13	0.00	1.00
Enfants Chablais Role N	17.00	2.00	0.00	19.00
Enfants Chablais Role Share	0.89	0.11	0.00	1.00
RAT Role N	15.00	6.00	0.00	21.00
RAT Role Share	0.71	0.29	0.00	1.00

Table 18: Covariate Data Childcare Networks Gender

	Female	Male	NA.	Other/prefer not to say	Total
AJEMA N	31.00	2.00	3.00	0.00	36.00
AJEMA Share	0.86	0.06	0.08	0.00	1.00
EFAJE N	25.00	3.00	2.00	0.00	30.00
EFAJE Share	0.83	0.10	0.07	0.00	1.00
Enfants Chablais N	16.00	3.00	0.00	0.00	19.00
Enfants Chablais Share	0.84	0.16	0.00	0.00	1.00
RAT N	16.00	2.00	3.00	0.00	21.00
RAT Share	0.76	0.10	0.14	0.00	1.00

Table 19: Covariate Data Childcare Networks Nationality

	Switzerland	Italy	France	Germany	Spain	Portugal	Turkey	Other	Libellé.réseau	NA.	Total
AJEMA nationality N	31.00	1.00	5.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	36.00
AJEMA nationality share	0.86	0.03	0.14	0.00	0.00	0.00	0.00	0.00	0.00	0.00	1.00
EFAJE nationality N	25.00	1.00	1.00	0.00	0.00	1.00	0.00	1.00	0.00	0.00	30.00
EFAJE nationality share	0.83	0.03	0.03	0.00	0.00	0.03	0.00	0.03	0.00	0.00	1.00
Enfants Chablais nationality N	17.00	0.00	0.00	0.00	1.00	0.00	0.00	1.00	0.00	0.00	19.00
Enfants Chablais nationality share	0.89	0.00	0.00	0.00	0.05	0.00	0.00	0.05	0.00	0.00	1.00
RAT nationality N	15.00	0.00	3.00	0.00	0.00	0.00	0.00	1.00	0.00	0.00	21.00
RAT nationality share	0.71	0.00	0.14	0.00	0.00	0.00	0.00	0.05	0.00	0.00	1.00

Table 20: Covariate Data Childcare Networks Firms' Involvement in Training

	Currently training	Involved in training in the past	Never	NA	Total
AJEMA N	23.00	2.00	8.00	0.00	36.00
AJEMA Share	0.64	0.06	0.22	0.00	1.00
EFAJE N	18.00	0.00	11.00	0.00	30.00
EFAJE Share	0.60	0.00	0.37	0.00	1.00
Enfants Chablais N	15.00	0.00	4.00	0.00	19.00
Enfants Chablais Share	0.79	0.00	0.21	0.00	1.00
RAT N	13.00	1.00	6.00	0.00	21.00
RAT Share	0.62	0.05	0.29	0.00	1.00

Table 21: Covariate Data Childcare Networks Membership in Réseau

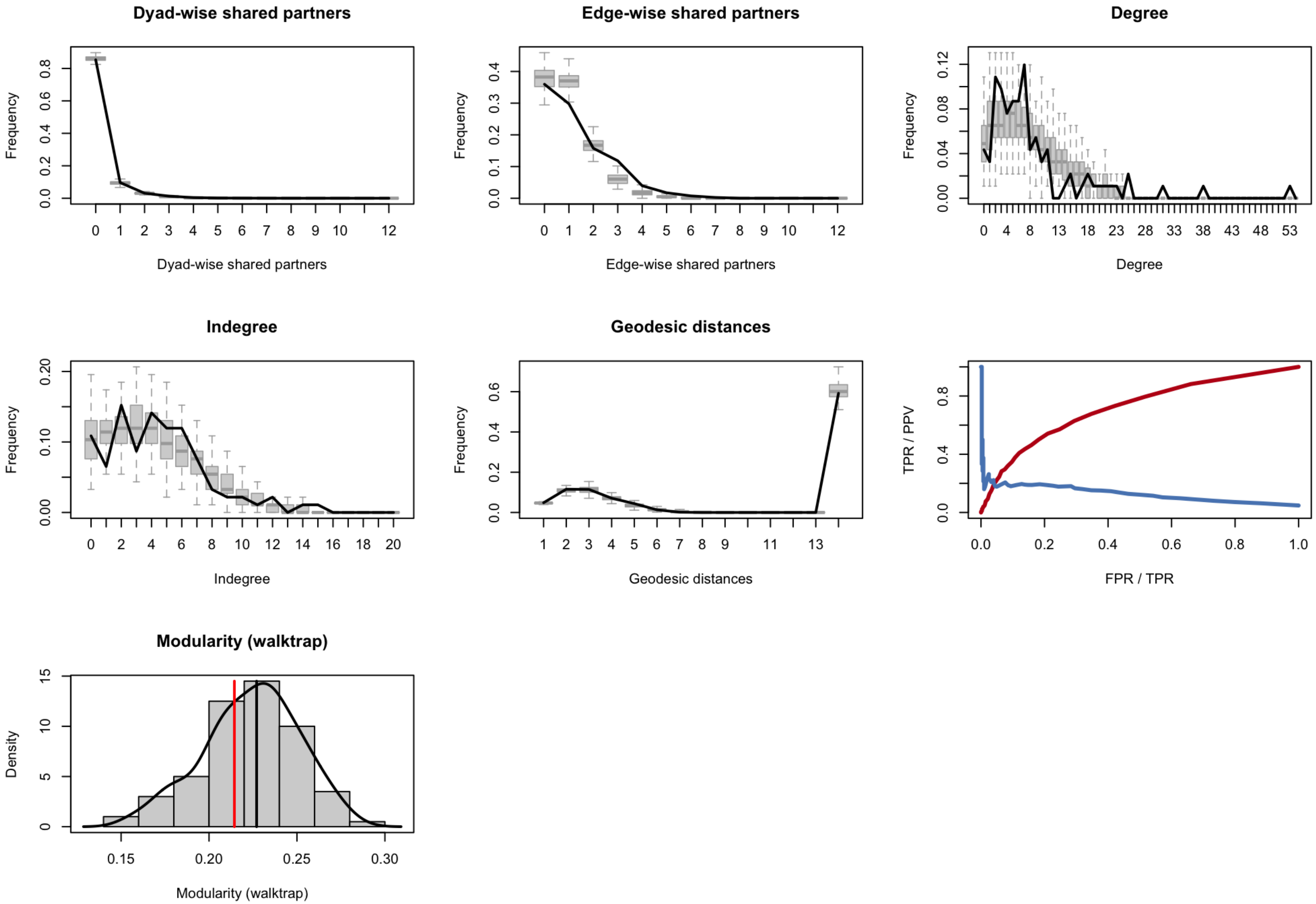
	Member	Not.member	NA.	Total
AJEMA N	24.00	12.00	0.00	36.00
AJEMA Share	0.67	0.33	0.00	1.00
EFAJE N	23.00	7.00	0.00	30.00
EFAJE Share	0.77	0.23	0.00	1.00
Enfants Chablais N	16.00	3.00	0.00	19.00
Enfants Chablais Share	0.84	0.16	0.00	1.00
RAT N	12.00	9.00	0.00	21.00
RAT Share	0.57	0.43	0.00	1.00

Table 22: Covariate Data Childcare Networks Type of Structure

	Private not subsidized not affiliated	Private subsidized affiliated	Public affiliated	NA	Total
AJEMA N	10.00	6.00	19.00	1.00	36.00
AJEMA Share	0.28	0.17	0.53	0.03	1.00
EFAJE N	7.00	9.00	14.00	0.00	30.00
EFAJE Share	0.23	0.30	0.47	0.00	1.00
Enfants Chablais N	4.00	3.00	12.00	0.00	19.00
Enfants Chablais Share	0.21	0.16	0.63	0.00	1.00
RAT N	6.00	4.00	11.00	0.00	21.00
RAT Share	0.29	0.19	0.52	0.00	1.00

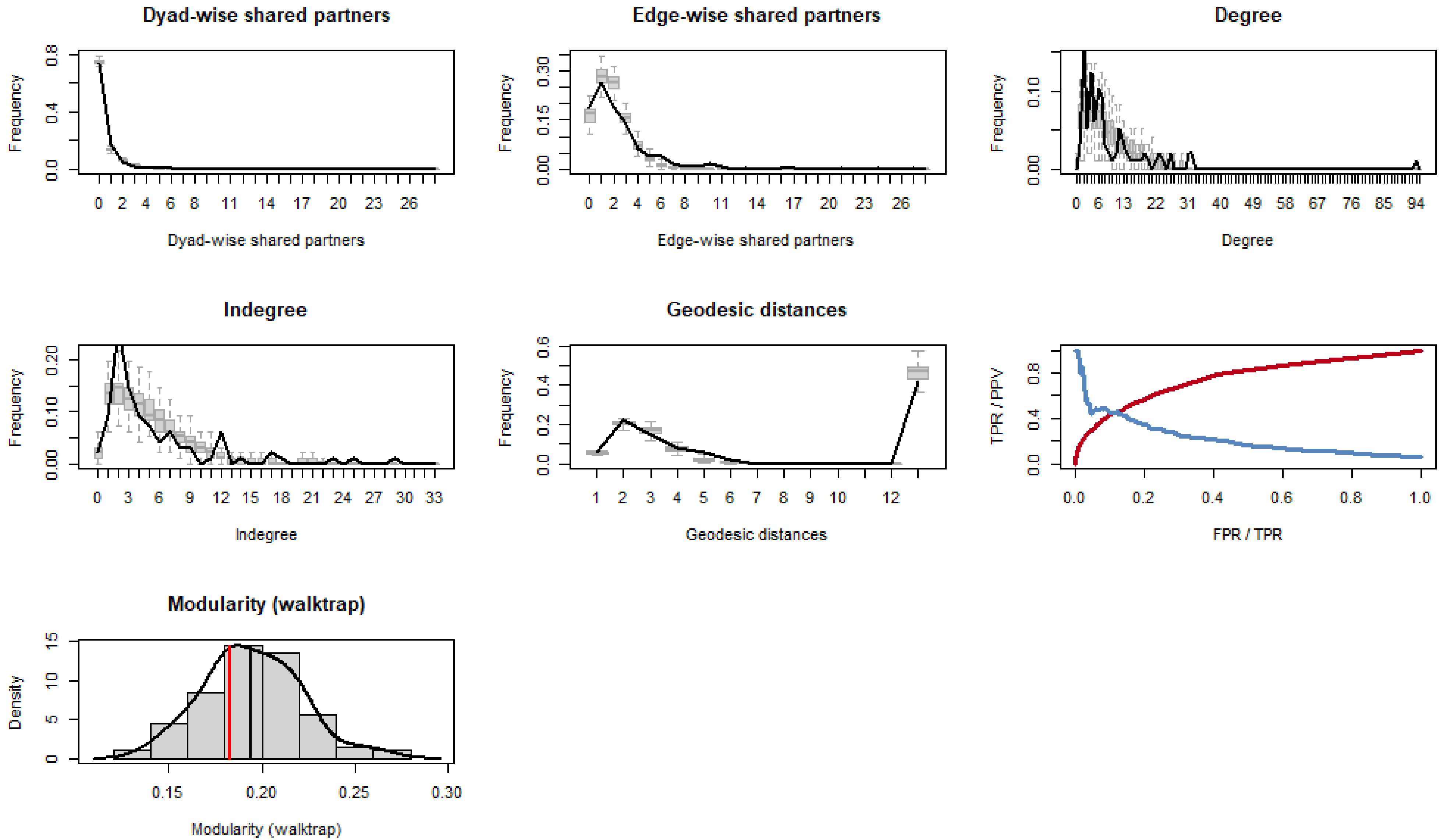
8.3 Goodness of fit plots for the fiduciary networks

Figure 1: Goodness of fit plot for Geneva network main model



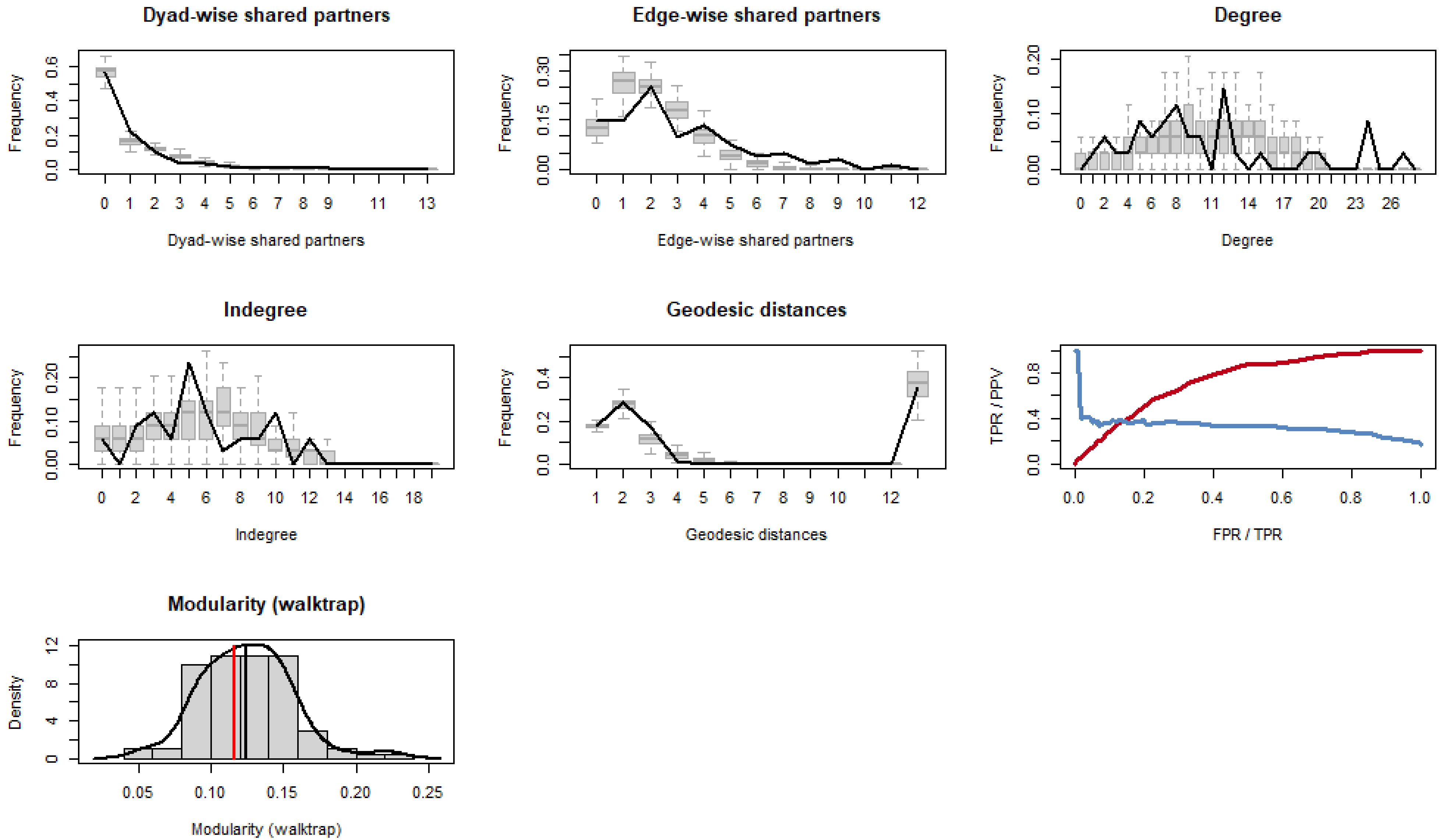
Notes: This figure shows how well the simulated networks correspond to the actually observed one.

Figure 2: Goodness of fit plot for Basel network main model



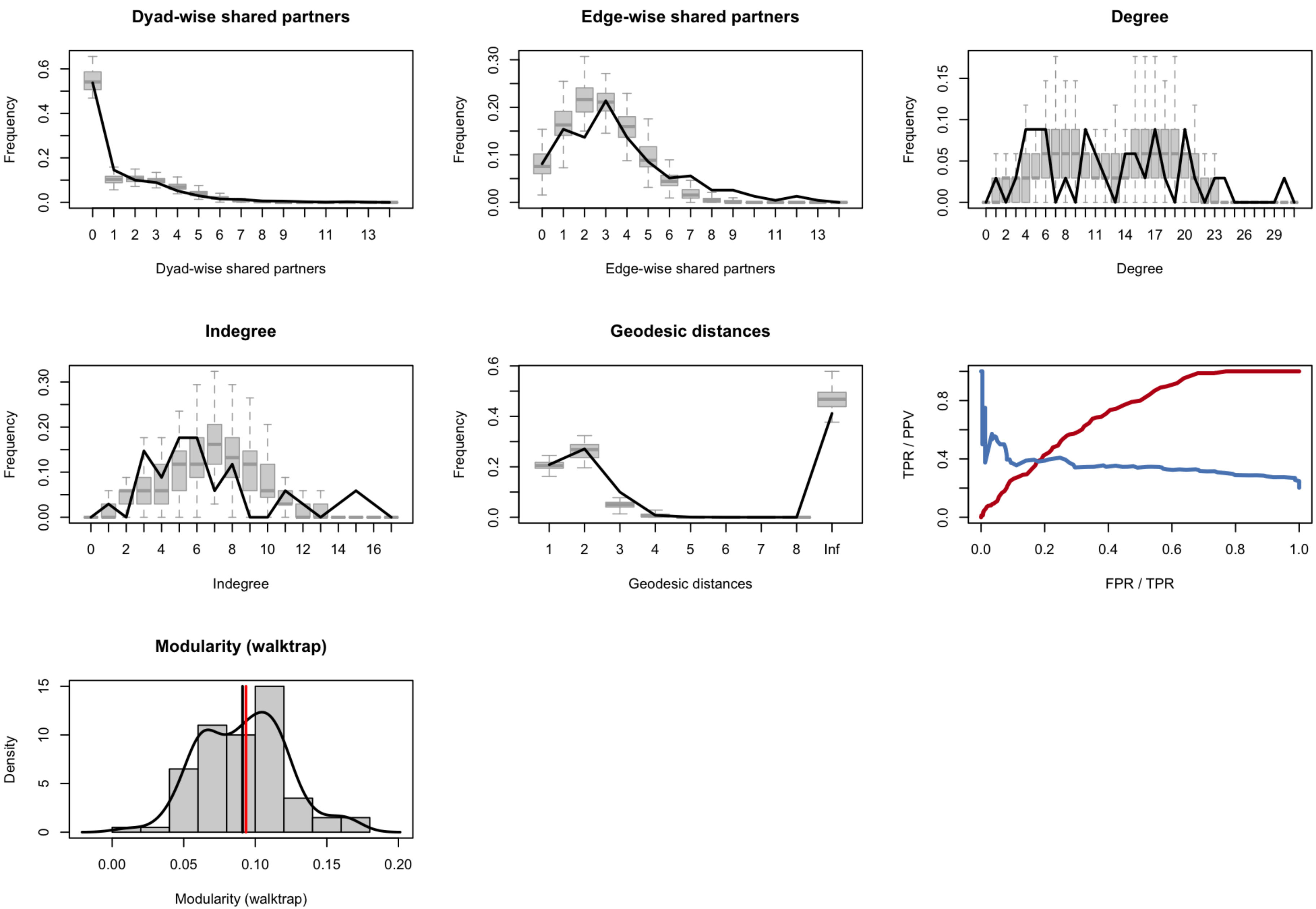
Notes: This figure shows how well the simulated networks correspond to the actually observed one.

Figure 3: Goodness of fit plot for Neuchâtel-Jura network main model



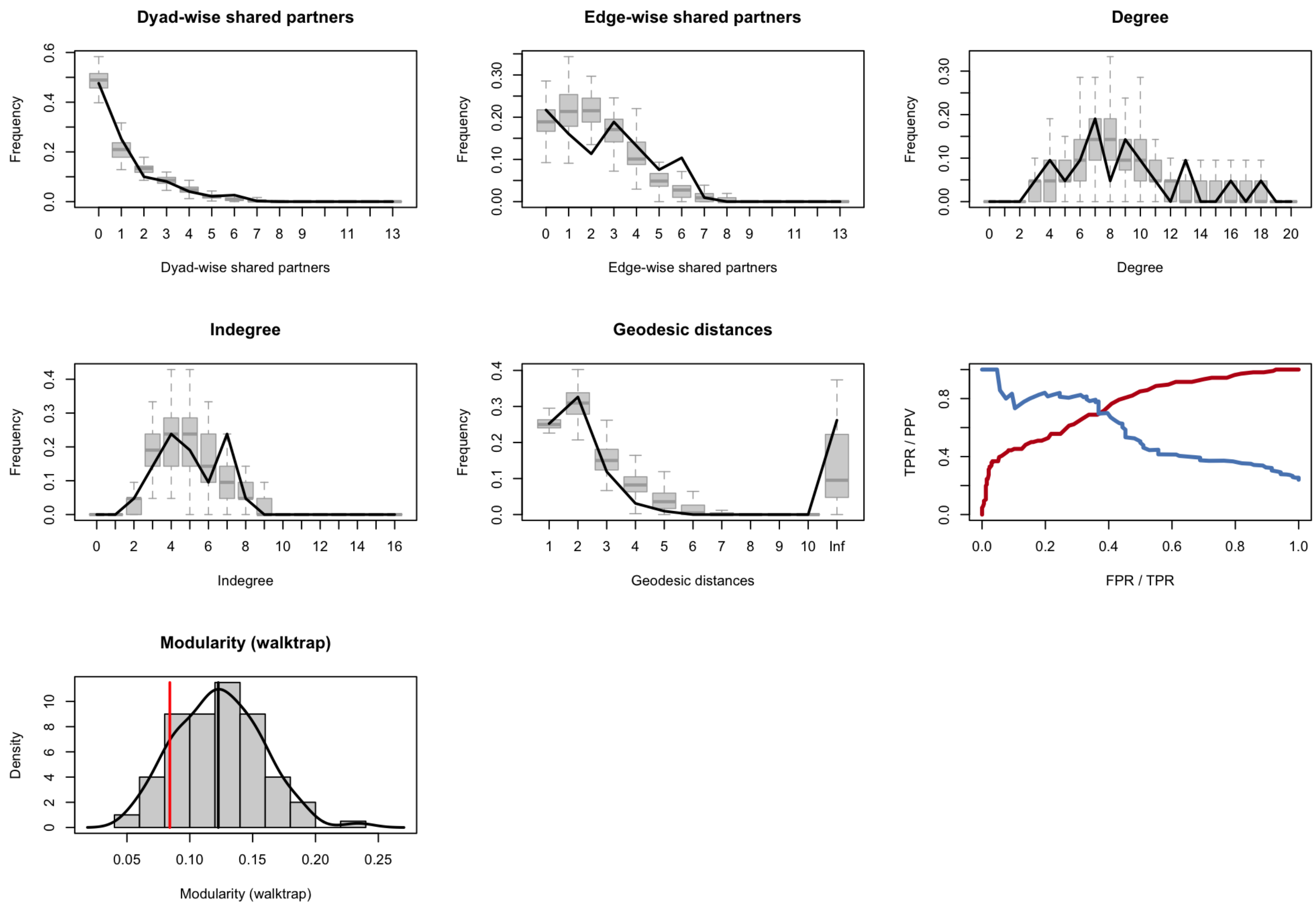
Notes: This figure shows how well the simulated networks correspond to the actually observed one.

Figure 4: Goodness of fit plot for Fribourg network main model



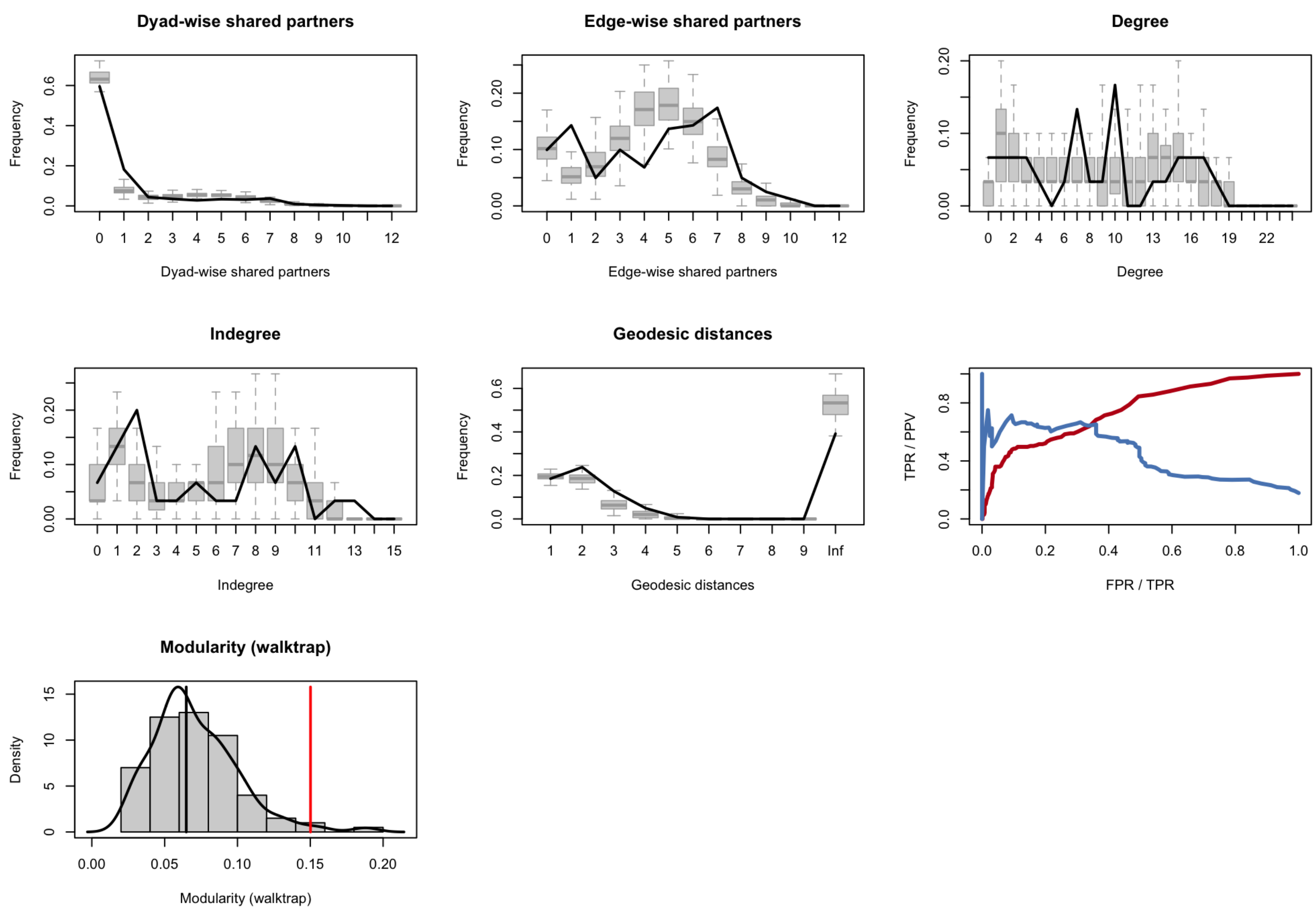
8.4 Goodness of fit plots for the childcare networks

Figure 5: Goodness of fit plot for RAT network main model



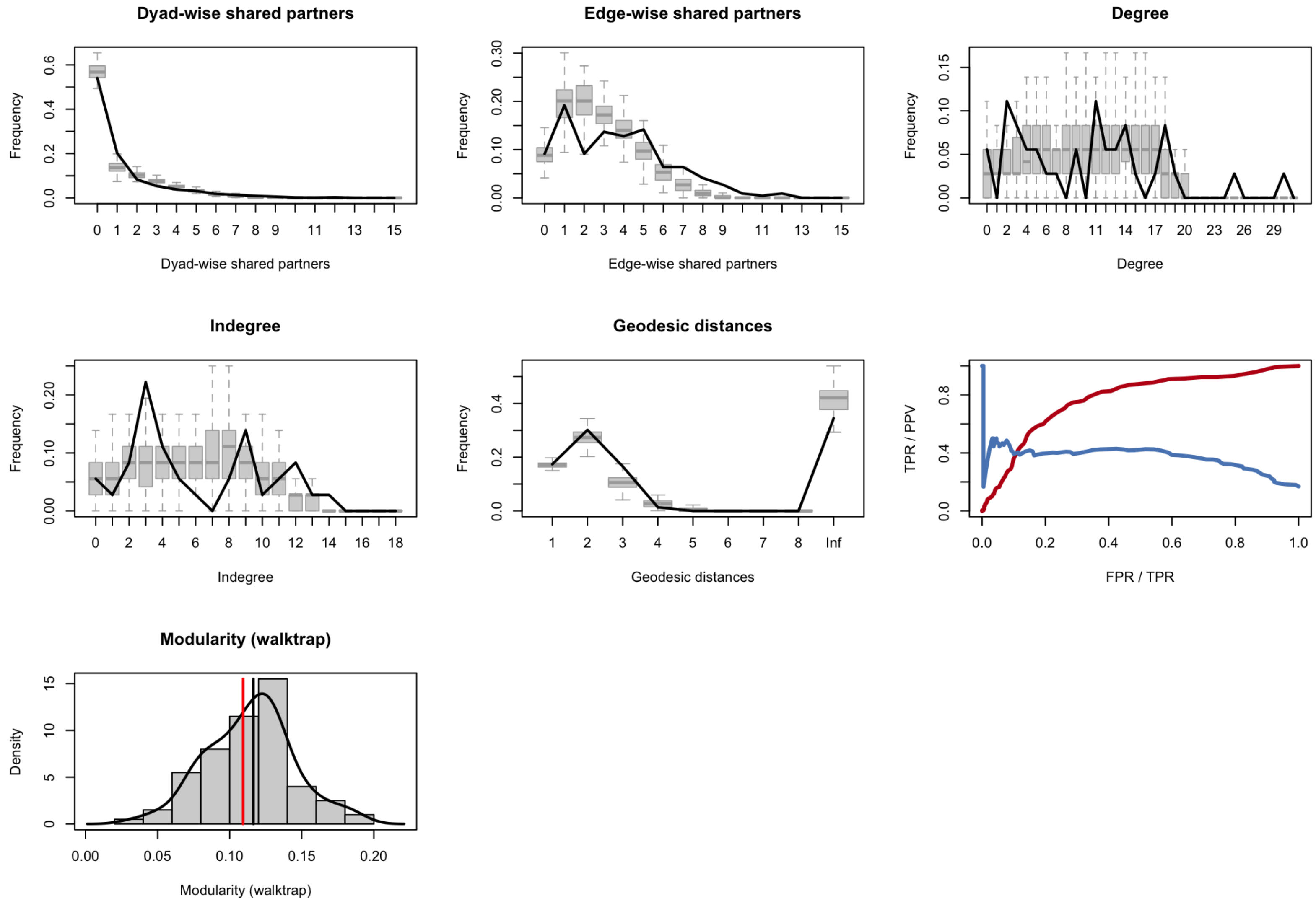
Notes: This figure shows how well the simulated networks correspond to the actually observed one.

Figure 6: Goodness of fit plot for EFAJE network main model



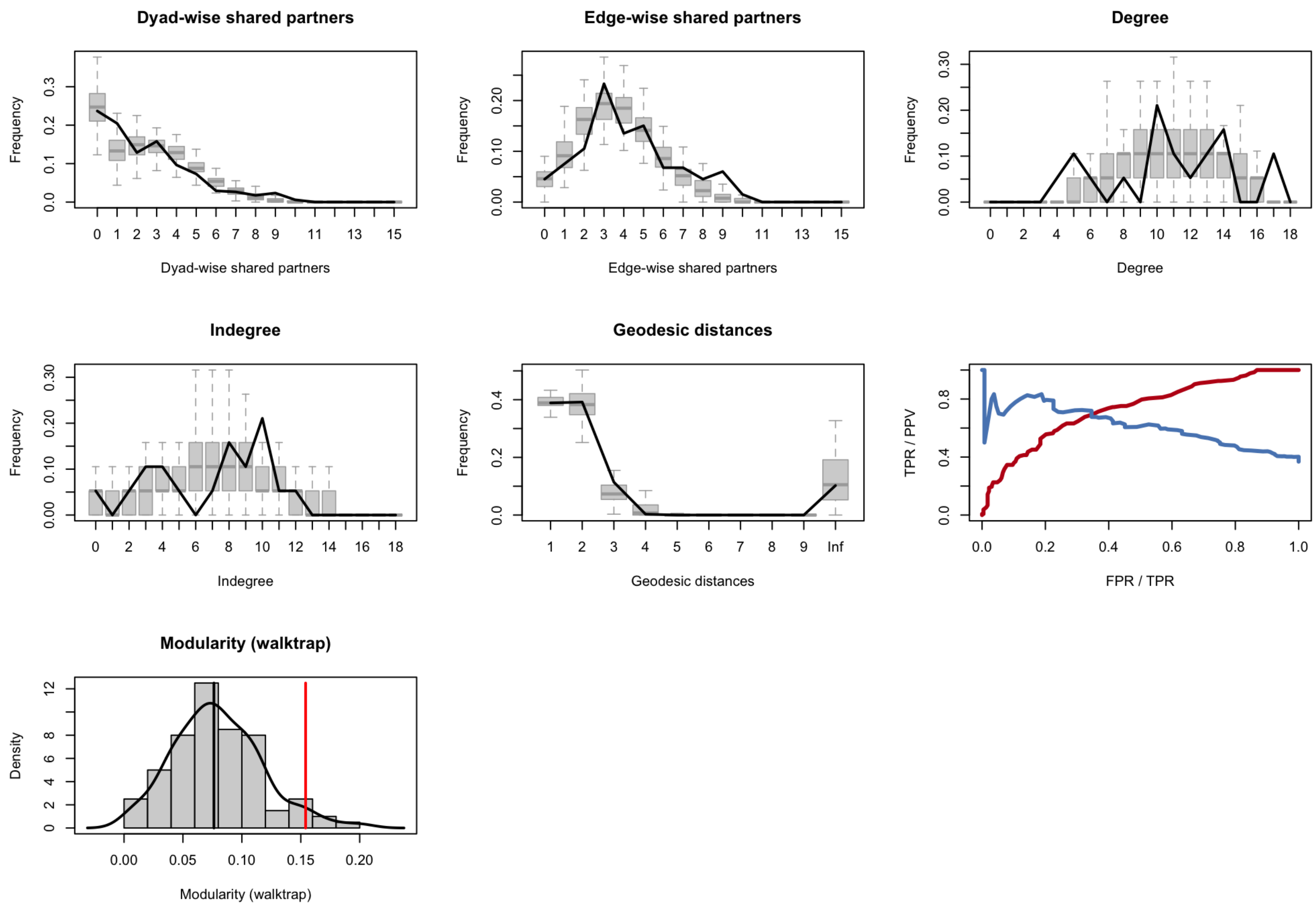
Notes: This figure shows how well the simulated networks correspond to the actually observed one.

Figure 7: Goodness of fit plot for AJEMA network main model



Notes: This figure shows how well the simulated networks correspond to the actually observed one.

Figure 8: Goodness of fit plot for Enfants Chablais network main model



Notes: This figure shows how well the simulated networks correspond to the actually observed one.