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Title

On the acoustics of policy learning: can co-participation in policy forums break up echo chambers?

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Abstract

Overcoming common-pool resource dilemmas requires learning across different sectors of society. However, policy actors frequently entrench themselves in so-called echo chambers by preferring to rely on information from those whose policy beliefs resemble their own. Policy forums can reduce the limiting effects of echo chambers by encouraging actors with diverse knowledge bases to exchange information and learn from one another. This paper applies exponential random graph models to network data from the South African tree plantation policy domain to investigate how belief homophily, reputational influence, and forum co-participation shape information exchange behaviour. Results show that echo chambers are important determinants of information exchange ties and that reputational influence is likely to "deepen" the echo. Results also show that the more forums that a pair of actors co-participate in, the more likely they are to exchange information. This applies to information exchange generally, as well as information exchange with trusted partners. Findings indicate that forums enable both cognitive learning (as knowledge gains) and relational learning (as improved relations). Nonetheless, when echo chambers are strong, and many forums are polarised, then forum co-participation may not break up echo chambers.

Keywords

Adaptive governance; Forest landscape restoration; Policy forums; Policy networks; Social learning; South Africa

1. Introduction

Policy-makers and practitioners at all levels struggle with how to address the parallel social and ecological pressures facing our societies and the common-pool resources that we depend on, especially where economic interests collide with environmental and social concerns (Biermann et al. 2012; Song 2018). In South Africa, examples of such common-pool resources are arable land, potable water, and biological diversity, all of which are affected by decisions over the development of fast-growing plantations of alien trees in large-scale monocultures (Bennett and Kruger 2013; Witt 2014). The tree plantation sector and the related policy network is characterised by controversies across a multitude of actors and their diverse interests, and the underlying power relations, beliefs, and knowledge bases. Determining which policy instruments to select, if any, in response to pressures on common-pool resources, requires policy actors to exchange information and to learn from one another, either to realise major policy change, or to strategically maintain the current status quo (Ansell and Gash 2008; Gerlak et al. 2018).

When actors gather and disseminate information, they gain access to knowledge, can navigate the credibility of the information in circulation, exert influence, pool critical resources, and build coalitions to improve the prospect of a favourable policy outcome (Leifeld and Schneider 2012). Realising the benefits and avoiding the costs associated with creating contacts (Feiock 2013), however, can lead to the formation of “echo chambers” – a tendency for policy actors to rely on information from those with beliefs that resemble and reinforce their own, while neglecting sources of information that contest or undermine them (Jasny et al. 2018; Jasny, Waggle, and Fisher 2015). Echo chambers are problematic because their existence may prevent actors from questioning embedded rules, roles, practices, assumptions, taboos, and beliefs, which is necessary for recognising and solving problems

(Koontz et al. 2015). On the other hand, policy forums (Fischer and Leifeld 2015), alternatively described as working groups (Klijn, Koppenjan, and Termeer 1995), advisory groups (Agrawala 1999), bridging organisations (Berkes 2009), stakeholder roundtables (Ponte 2014), and collaborative institutions (Lubell 2004), can enable learning by inviting policy actors to step outside their echo chambers. Yet, diversity rarely comes without inefficiencies and power asymmetries, both of which can influence the likelihood that a forum would break up an echo chamber (Fischer and Maag 2019; Reed et al. 2018).

In this paper, we ask if participation in policy forums can break up echo chambers in the South African tree plantation policy network – where powerful sectoral economic interests are present and there is a need to adapt to environmental change and create economic opportunities for a growing population while the legacy of apartheid and social inequalities remains still tangible (Biggs et al. 2015; Bishop 2006; Reid and Vogel 2006). Using Exponential Random Graph Models (ERGMs), we investigate if actors in this network tend to exchange information (and build trust accordingly) with i) those with policy beliefs similar to their own (i.e. echo chamber effect), ii) those that have a reputation of being influential (i.e. resource pooling effect), or iii) those that they encounter in forums. By testing well-established hypotheses about policy actors' behaviour in a novel context and in relationship to different forms of learning, we can explore their nuances in our empirical case and contribute to the wider literature on policy learning.

This paper is organised as follows. First, we present the arguments from which we develop our three hypotheses. Second, we outline our empirical case, data, and methods. Third, we describe the actors' participation in forums and present the ERGM results. Finally, we discuss

our results and the implications of our findings for our empirical case, theory, and future research.

2. Theoretical framework and hypotheses

Policy to address common-pool resource dilemmas is increasingly crafted in polycentric, complex institutional systems – that is, collections of actors, resources, and formal rule-based institutions under which actors order their informal interactions to attain various policy goals (Berardo and Lubell 2019). Networks, in turn, offer a useful lens for their analysis (Bodin et al. 2019; Scott and Ulibarri 2019).

The diversity of policy institutions embedded in complex institutional systems lays the foundations for policy learning (Henry 2018; Ostrom 2005). Policy learning, meaning the acquisition, translation, and dissemination of information among actors with diverse bases of knowledge (Heikkila and Gerlak 2013), encompasses the cognitive and social dynamics that help actors to challenge those institutions. Here, we divide such dynamics into cognitive and relational learning. Cognitive learning refers to knowledge gains that occur through the acquisition or restructuring of knowledge and any consequent changes in perspectives. Relational learning, on the other hand, refers to processes that enable and lead to improvements in the relations between actors (Koontz 2014). Information exchange allows cognitive learning to take place when actors interact with one another by sharing diverse perspectives and experiences, as well as co-producing knowledge that is relational and collectively oriented (Muro and Jeffrey 2008; Schusler, Decker, and Pfeffer 2003). This process includes an emergent collective property through group interactions that fosters relational learning through consensus, commitment, and trust accumulation (Ison, Blackmore, and Iaquinto 2013). Both are potential outcomes of institutional arrangements that introduce

actors to new ideas and enable them to engage in deliberation with knowledgeable others from different backgrounds (Siddiki, Kim, and Leach 2017).

Loci of such learning can be policy forums. Policy actors can often choose which, if any, forums they wish to attend, which they do by weighing up the advantages (e.g. learning) and disadvantages (e.g. time) of participation (Feiock 2013; North 1990). The reach and longevity of each forum, however, conditions the diversity and engagement of participants. In this paper, "forums" serve as an overarching concept capturing all kinds of events or venues that promote co-ordination among policy actors across private, public, and social sectors of society (Maag and Fischer 2018; Wagner and Ylä-Anttila 2018).

However, one must not mistake learning for its possible outcomes. The same outcomes can be achieved through other mechanisms and learning can occur in the absence of any salient outcome (Reed et al. 2010). Rather, learning moulds the institutions to "fit" the context in which they exist (Lebel et al. 2013). It remains unclear how actors learn from one another and how does learning occur in different policy contexts (Moyson and Scholten 2018). Given that information exchange is instrumental for achieving any degree of policy change as an outcome from learning, we present three hypotheses regarding policy actors' information exchange behaviour: i) belief homophily; ii) reputational influence; and iii) co-participation in policy forums.

Empirical investigations across multiple policy contexts have consistently found that policy actors with similar beliefs tend to form relational ties (e.g. Henry, Lubell, and McCoy 2011; Ingold and Fischer 2014; Matti and Sandström 2013). Following several contributions to the literature, we refer to this tendency as belief homophily (Henry, Lubell, and McCoy 2011). The

idea that belief homophily breeds connections in policy networks is a special case of the more general notion of “homophily” – the well-documented selection bias that drives human beings to limit their social worlds to those who are similar in one way or another (Goodreau, Kitts, and Morris 2009; McPherson, Smith-Lovin, and Cook 2001).

The policy beliefs held by actors in a geographic and substantive policy context can be highly resistant to change, even in the face of contradictory evidence. In line with the Advocacy Coalition Framework (ACF) (Jenkins-Smith et al. 2014), we attribute this resistance to biased assimilation, a cognitive bias which causes actors to systematically chase information from sources that support their prior beliefs (Dandekar, Goel, and Lee 2013; Lord, Ross, and Lepper 1979). When actors fail to interpret information in the same way it may breed distrust and erode co-ordination efforts (Leach and Sabatier 2005). In information exchange networks, biased assimilation can lead to actors forming echo chambers (Jasny, Waggle, and Fisher 2015), which, perhaps unlike coalitions founded on more intensive forms of co-ordination, can relatively rapidly reorganise around beliefs concerning salient policy instruments (Jasny et al. 2018).

Working with like-minded actors who share the same strategies is advantageous and often instrumental for turning policy beliefs into actual policy (Baumgartner and Jones 1991; König and Bräuninger 1998). In other words, communicating with those that think alike is likely to carry the highest utility. Consequently, communication occurs inside echo chambers rather than between them. From another perspective, but in line with the learning component of the ACF, actors might well be willing to exchange information with those that they may disagree to convince them of their own ideals and optimal policy design (Sabatier and Jenkins-Smith 1993).

The political and economic implications of interventions that would effectively address the environmental and societal problems in South Africa might encourage those in an influential position in society to defend their prior attitudes and actively neglect incongruent arguments without having to recognise the full scale and implications of the problems. However, those in favour of radical interventions to change the status quo might also ignore those with information that would discredit the seriousness of the problem, perhaps perceiving such information to be offensive. It can be difficult for policy actors to admit that they are wrong (Leach et al. 2014). We set out our first hypothesis concerning the role of belief homophily in shaping information exchange behaviour:

H1: Policy actors tend to exchange information with those with policy beliefs that are more similar to their own

Scholars informed by Resource Dependence Theory (RDT) have challenged the assumption that belief homophily is the most significant factor that causes policy actors to come together. The RDT builds on a more general notion of organisational resources determining co-ordination among organisations (Pfeffer and Salancik 1978). When applied in the policy studies literature, the RDT has been used to argue that no single actor possesses enough resources to influence policy alone, and that this causes actors to pool resources to control or absorb uncertainty (Stokman and Berveling 1998; Weible 2005). Forming a relationship with influential actors that have access to or control over critical resources (e.g. finances, intelligence, personnel, and technology) is likely to provide the most utility.

RDT, however, does not necessarily compete with the belief homophily hypothesis. For example, Henry (2011) finds that co-ordination on the basis of influence attribution is conditional on belief homophily. Direct co-ordination with influential actors can be costly in the sense that one must compete for attention with many others. Rendering additional benefits, that burden can be reduced by turning to like-minded influential actors (D'Souza et al. 2007). When led by actors that are instrumental to policy success, the benefits of working with others can be substantial (Hojnacki 1997). From this perspective, the resource pooling effect is more likely to "deepen" the echo in the chamber, complementing, rather than contesting, the role of beliefs in shaping actors' information exchange behaviour. Weible (2005), however, offers another viewpoint, suggesting that when influential actors oversee critical resources, they implicitly force others to co-ordinate with them regardless of their policy beliefs.

Reputational influence comprises an important sign of quality. It provides a subjective, yet encompassing view of influence by uncovering parts of the "hidden" face of power in politics (Bachrach and Baratz 1962). These include the ability to control critical resources and exploit an informal, but extensive structural position in the network (Fischer and Sciarini 2015). Reputational influence determines how others understand the different policy actors and their roles, which directly feeds to their ability to forge policy outcomes (Ingold and Leifeld 2016). Influential actors, in turn, have considerable latitude in choosing their channels (and content) of communication (Leifeld and Schneider 2012; Moeliono et al. 2014). We rephrase Weible's (2005) original hypothesis as follows:

H2: Policy actors tend to exchange information with those that have a reputation of being especially influential

Policy forums as institutionalised forms of exchange can enable policy learning by allowing participants to deliberate and circulate information with actors beyond their regular co-operation networks (Fischer and Leifeld 2015). In complex policy or managerial environments, convening diverse sets of actors in forums can bring resources and expertise together to increase understanding of an issue and related technicalities (Maggioni, Nelson, and Mazmanian 2012). They can also foster more appropriate approaches that acknowledge how policies affect different stakeholders (Levesque et al. 2017).

In reality, the picture drawn of forums that deal with common-pool resource dilemmas affecting many actors in different ways is often less rosy. Instead of seeking to learn from the variety of viewpoints to which an actor is exposed, they may participate in a variety of forums to spread influence and achieve their goals. Decisions made (or awaited to be made) in one forum can hold back those to be made in other forums (Mewhirter and Berardo 2019). Participants may opt to participate in forums that jointly provide the highest utility, dismissing those that they perceive as an inefficient use of resources (Scott and Thomas 2015; Smaldino and Lubell 2011). A biased representation of actors with selfish or opportunistic motivations can impede learning by bringing forward selective information and narrowing down the range of policy options (Lockie 2013; McAllister, McCrea, and Lubell 2014). High costs of participation can reinforce the influence of already resourceful actors, who may be advantaged by creating or destroying forums, which increases the chances that will obtain their preferred distribution of costs and benefits (Gallemore et al. 2015).

Nevertheless, by participating in forums actors can reduce the transaction costs associated with voicing concerns, expressing preferences, bargaining for contractual terms, and learning (North 1990). The costs of collecting information about the nature of a dilemma, as well as the

actors and policy instruments at play, are also reduced by attending forums. The expectation is that the benefits of participation outweigh its costs (Feiock 2013).

Recent research on the role of forum co-participation in explaining actors' co-ordination efforts has yielded inconsistent findings. Wagner and Ylä-Anttila (2018), for example, find that actors' in the Irish climate policy network did not source policy advice from those that they encounter at forums. Others have found that when actors participate in more of the same forums that they are more likely to co-operate, co-implement policy, or engage to informal consultations (Fischer and Sciarini 2016; Hamilton and Lubell 2018; Scott and Thomas 2015). However, the odds of participants being exposed to new ideas and information in policy forums, which result in new relations, can be high (Siddiki, Kim, and Leach 2017). Those that co-participate in multiple forums are more likely to be aware of each other's existence and the types of information that they possess, increasing the odds of them forging a relationship. Based on these arguments, we formulate our last hypothesis as follows:

H3: The likelihood that policy actors exchange information increases as they participate in more of the same policy forums

Policy dilemmas tend to involve uncertainty over information, and trust in the reliability and accuracy of information is essential for policy learning (Henry 2009; Sabatier and Jenkins-Smith 1993). Importantly, beliefs may influence trust in information and, by proxy, trust in actions. The credibility of information can be hard for most actors to evaluate and they are thus likely to read information on the basis of how well it is in line with their own beliefs, and build trust accordingly (Henry and Dietz 2011, 2012). The psychological safety brought about

by trust, in turn, enables the willing contribution of one's ideas and actions to collective effort (Edmondson 2004).

For this reason, we test whether the behavioural dynamics of information exchange differ from those of information exchange with trusted partners. Information exchange is thought to be a less intensive, and less risky, form of an interaction than building and maintaining trust. Moreover, and unlike information exchange, any institutional rule cannot mandate a climate of trust. We expect to see stronger positive effects of belief homophily and reputational influence on the latter, and forum co-participation on the former. In other words, we expect to see forum co-participation as a function of cognitive rather than relational learning. This way, we contribute to a more nuanced understanding of these hypotheses across policy contexts, and in the context of different learning processes.

3. Case, data and methods

3.1 Case

South Africa is a semi-arid country, where the mountainous catchments receive most of the rainfall responsible for sustaining the perennial streamflow (Dye and Versfeld 2007). The early colonial governments, followed by national governments since 1910, encouraged and eventually embarked on large-scale planting of alien trees to supply local uses (Kruger and Bennett 2013). However, the trees that appeared in the upstream soon led to conflicts with downstream water users. The debate went on until the government started regulating the extent of plantations in 1972 based on their effects on streamflow estimated from a series of controlled catchment experiments. The National Water Act of 1998 revised this piece of regulation and made the planting of alien trees, some of which encroach riparian areas and displace native species, a subject to complex licensing and fees (van Wilgen and Richardson

2014; Witt 2014). Since, the plantation extent has shrunk from 1.53 million hectares in mid-1990s to 1.22 million hectares in 2016 due to land conversions and various damage agents. South African climate projections suggest that water stress will increase and that this will reduce the already small area available for tree planting (DEA 2018; Warburton and Schulze 2008).

In a country with an unemployment rate floating around 25% and half of a growing population living in poverty (DNT 2016), tree plantations support an economic sector with contributions to foreign trade balance and the creation of basic jobs in the rural areas. The pine and eucalypt plantations, the majority of which are under private ownership, concentrate in the five provinces along the eastern seaboard (Figure 1).

Figure 1. Tree plantations in South Africa (own elaboration based on DEA, 2014).

Since the end of apartheid, South Africa has been going through a land reform process under the Restitution of Land Rights Act of 1994. Those who were either forcefully relocated or forced to become labour tenants under the racially discriminatory Land Act of 1913 are entitled to a restitution of that property or an equitable redress (Cousins 2009). Although the currently valid window for claims closed in 1998, progress has been slow due to some lands having been acquired legally somewhere between 1913 and the present. The government has redistributed its own lands, while often remaining a shareholder on behalf of the actual beneficiaries in order to maintain production, pay dividends to beneficiaries, and to enable knowledge transfer (Dlomo and Pitcher 2005). Land reform was designed to become a means of wider decolonisation of South Africa, but critics argue that the approach taken reproduces the paternalistic relations of the apartheid and contributes to elite capture (Kepe and Hall

2018). Around 40% of the private plantation land and 70% of the plantation land that still belongs to the government remain under claim (Chirwa et al. 2015).

The overarching objective in South Africa is to achieve large-scale poverty alleviation without undermining the ability of natural ecosystems to support the well-being of future (and current) generations (Biggs et al. 2015). Contention over the objectives and solutions, as well as the scientific validity of policies, however, has become a distinctive feature of the national tree plantation policy domain (Bennett and Kruger 2013; Dye 2013; Tewari 2001; van Wilgen and Richardson 2012; Witt 2014). While information asymmetries reportedly continue to limit the previously disadvantaged groups' agency and trust in formal institutions (Goldin 2010), there are many other sectors of society that share an interest in the scarce common-pool resources of South Africa, including the government, private sector, labour unions, and civil society. There are also several policy forums at different scales of operation and debates about suitable policy instruments, including indicative land use zoning to expand tree plantations in the provinces of KwaZulu-Natal and Eastern Cape.

3.2 Data

We collected data in South Africa in 2017 using semi-structured face-to-face interviews with 55 organisations affected by or interested in tree plantations as a specific form of land use. Because organisations are in the vanguard of modern politics and form the context through which learning occurs (Knoke et al. 1996), we chose to focus on the learning of organisations rather than individuals. We identified the focal organisations by drafting a list, a roster, of organisations based on publicly available information, which three independent experts with a deep knowledge of the given policy context then reviewed. Based on their comments, the roster was refined and increased to 59 organisations. Supplementary information (SI) includes

the final roster in its entirety. Four organisations either declined to be interviewed or could not participate due to recent changes in their administration. We omitted these four organisations from our analysis.

We identified and contacted the representatives of the 59 organisations through various means, including contact directories and contact information for specific individuals received from other representatives. We sought representatives that were in an executive position in each organisation (e.g. executive and deputy directors, senior advisors, professors and principal investigators, national and provincial co-ordinators, and government commissioners) to ensure that the views articulated were those of the organisations, rather than the individual. Representatives were assured their titles and names would remain confidential, and it was explained to them how the data would be treated once the project was complete. We also asked for the consent of all representatives, without which we would not have conducted the interview. All interviews were in English.

We collected data on policy beliefs by asking the representatives to set out their preferred vision for the future of tree plantations in South Africa and to elaborate on their realistic expectations. We then asked them to cite any specific challenges that they saw as barriers to realising this vision. By using open-ended questions, we sought to understand the tensions between the multitude of framings and meanings attached to ideas and concepts relevant to the policy context (Hajer 1995). We also asked specific questions about the consequences and feasibility of indicative land use zoning in Eastern Cape, as well as on the efficiency, equity and effectiveness of various policies and decision-making processes in the domain. Hence, each organisation was encouraged and inclined to bring forward the issues most salient to them at the time of data collection.

All interviews were transcribed before coding them using the discourse network analysis (DNA) software (Leifeld 2010). DNA combines qualitative content analysis with social network analysis to create relational data by connecting actors into networks based on their agreement or disagreement with specific concepts (Leifeld 2017). In our case, these concepts are categories of policy beliefs. The DNA software, which relies on researcher expertise and their informed judgment, involves analysing the statements made by organisations and creating links between the two. Organisations that express a common stance for or against a belief category form a network tie. The more beliefs that a pair of actors share, the deeper the connection between the two.

In total, we extracted 656 different statements from the interviews with the 55 organisations. These were coded using 40 different belief categories. For this study, we focus on 12 beliefs, including stances for and against (as separate categories) three general policy beliefs and three specific policy instruments. Statements that fall under these 12 belief categories represent 33% of all statements made. We chose these categories because a large share of actors made statements either in favour or against them, meaning that they are the most salient issues to the actors in the network. In addition, patterns of co-ordination often form on the basis of more general empirical or normative policy beliefs (Jenkins-Smith et al. 2014), but sometimes also on the basis of beliefs concerning specific policy instruments alone (Jasny et al. 2018; Leifeld 2013).

The general policy beliefs concern:

i. the validity and role of environmental regulation in the policy domain;

ii. the balance of social costs and benefits of tree plantations and associated industrial activities; and
iii. the conditionality of using land reform as a means of an equitable decolonisation in South Africa.

The policy instruments' belief categories concern:

i. the role of voluntary certification to sustainability standards developed by multi-stakeholder initiatives;
ii. multi-functional and locally controlled management of tree plantations; and
iii. the consequences of the indicative zoning of Eastern Cape for tree plantations.

We also collected relational data during the interviews by presenting the roster of network actors to the representatives of each organisation and by asking them to indicate which actors they recognised as information exchange partners. We controlled for the voluntary nature of information exchange by allowing the representatives to tick an "only when necessary" option. We also asked them to indicate which actors they considered to be especially influential, and to indicate which actors they co-operated with by exchanging funds, resources, or in any other way, such as collective bargaining. In addition, we asked them to rank how highly they trusted those organisations that they identified as information exchange partners on a five-point scale from zero to complete. The cut-off point for past interactions was set at the last three years. We collected data on organisations' participation in twelve policy forums identified through an analysis of scientific and grey literature, policy documents, and websites, although the interview data complemented these data (see SI).

3.3 Methods and variables

We test our three hypotheses by fitting a series of Exponential Random Graph Models (ERGMs) to our network data using the statnet package for the R programming language (Goodreau et al. 2008; Handcock et al. 2003). ERGMs allow us to investigate multiple theoretical hypotheses about network dynamics simultaneously and to understand how they interact to produce an observed network (Cranmer and Desmarais 2011). In other words, they allow us to determine, with some confidence, the factors associated with the formation of information exchange ties between actors (and build trust accordingly).

ERGMs allow for statistical inference on relational network data, which by definition are non-independent. Generalised Linear Models (GLMs) are unable to account for this non-independence and would therefore erroneously attribute explanatory power to exogenous factors: probability values of exogenous factors would turn out being too optimistic, standard errors too small, and error terms would be correlated across observations (Cranmer and Desmarais 2011). Non-independence implies that the probability of observing a given configuration of ties and nodes might depend upon the structural attributes of the network. ERGMs test if the observed network configuration is explainable by the set of network statistics and covariates included in a model, with the probability of these being present in a network expressed in terms of parameter estimates and their standard errors. However, when testing causal hypotheses of social behaviour using stochastic ERGMs and cross-sectional data, the method is limited to identifying characteristic signatures of an evolutionary trajectory and cannot always rule out local social processes that generate dyadic relationships and depend on the local social environment (Robins et al. 2007).

Our first dependent variable, the information exchange network, corresponds to a binary adjacency matrix, in which the rows and columns represent the 55 organisations in the network, with the presence or absence of information ties marked by one or zero, respectively. The ties are asymmetric and self-loops are not possible since organisations cannot exchange information with themselves. Although the network does not contain information about which direction each actor sends information, its directedness indicates which actors identified others as their information exchange partners. We investigate the trust accumulation aspect of relational learning using our second dependent variable. We construct this variable by taking the intersection of high trust (four or five on our five-point scale) and voluntary information exchange, resulting in a directed and binary adjacency matrix that represents a trusted information exchange network.

We test our first hypothesis on “belief homophily” using a distance matrix that quantifies the similarity in the beliefs of each pair of actors. We first convert the original output from the DNA software, a 55x12 organisation-belief matrix (opposing stances as separate categories) into a 55x6 matrix, where we code stances for (or agreement) or against (or disagreement) each of the six beliefs as +1 (for), 0 (neutrality), or −1 (against). We use this matrix to construct a dissimilarity matrix containing the Manhattan distance between the beliefs of each pair of actors in the network (Cranmer et al. 2017). By subtracting each dissimilarity value from the maximum dissimilarity value, we receive a similarity matrix that we use to operationalise belief homophily in our model. This matrix is equivalent to an undirected and weighted network, with larger distances between pairs of actors implying more similar beliefs.

We include two endogenous terms to model the existence of network structures that capture information exchange dynamics indicative of echo chambers. The Geometrically Weighted

Edge-wise Shared Partner ("GWESP") term models the tendency for actors in networks to close triads, capturing how frequently two directly linked actors are simultaneously indirectly linked to one another through a third actor (Hunter 2007). The Geometrically Weighted Dyad-wise Shared Partner ("GWDSP") term captures the presence of configurations where actor *i* and actor *j* are both linked to actor *k*, regardless of whether *i* and *j* are linked to one another. Echo chamber effects are present in a network when actors have a tendency to close triads and where behaviour that would leave triads open is unlikely to occur.

We test our second hypothesis on "reputational influence" using a variable that we construct by summing up the influence judgments that each actor passively received from the other actors in the network (Fischer and Sciarini 2015). Actors with higher scores have more reputational influence. There is a risk, however, that our representatives employed different criteria to form their judgements, navigating a range of cues. They could have misperceived the influence of others or used the subjective measure instrumentally to boost their own influence. We will thus control for the institutional determinants of influence attribution by including an "institutional influence" variable to account for the ties incoming to government departments with formal decision-making authority (König and Bräuninger 1998). This is an important control term in the South African context, where the same tripartite alliance has retained its absolute majority of the seats in legislature since 1994.

We test our third hypothesis on "forum co-participation" by converting the data on actors' participation in the twelve policy forums into an undirected co-participation matrix. Each cell in the matrix includes the count of the number of times that two actors participated in forums together. We include a "forums participated" variable to control for the number of forums that each actor participated in. This allows us to distinguish between information exchange ties

that are formed by actors that have a greater propensity to participate in forums from those that are formed between pairs of actors that participated in the same forums.

We add several control variables that capture or represent relationships frequently observed in policy networks. The “edges” term is included to account for the propensity of actors to report their information exchange behaviour in the first place, and is similar to the intercept in a linear regression. We include a “reciprocity” term to model the tendency for actors to reciprocate recognition as an information exchange partner. We control for the tendency for actors to exchange information with those with which they co-operate by including a binary adjacency matrix of the co-operation network (“co-operation”). Finally, we include the Geometrically Weighted In-degree (“GWI”) term to control for the presence of preferential attachment. If actors establish ties preferentially to more popular actors, the resulting distribution of the number of ties that actors share with others are geometrically discounted and summed to the statistic (Barabási and Albert 1999; Cranmer et al. 2017).

4. Results

4.1 Participation in forums

Before turning to our ERGM results, we provide a descriptive analysis of the forums data and of the beliefs of those that participated in the forums. Figure 2 describes the policy beliefs raised in the interviews and over which the actors disagree. These include stances for and against the general policy beliefs and for and against the three specific policy instruments beliefs The three general policy beliefs seem more divisive than the beliefs concerning policy instruments, which are supported and resisted by less uniform assemblages of organisations.

Figure 2. Polarisation over salient policy beliefs by actor type.

In the eight policy forums with the most participants, actors with beliefs that span nearly the full breadth of all the beliefs expressed have many opportunities to encounter one another. In Figure 3, the x-axis shows the eight forums with most participants. The y-axis refers to the normalised belief distance between each pair of actors, and every point on the graph refers to a pair of actors that participated in each forum. Points at the bottom of the graph refer to pairs of actors with more dissimilar beliefs, while points towards the top refer to pairs of actors with more similar beliefs. Table 1 provides descriptive information about the most popular forums.

Figure 3. Normalised belief distance between pairs of actors in the most popular forums (FSS: Forest Science Symposium; TPCP: Tree Protection Co-operative Programme; FSCC: Forest Sector Charter Council; BDWG: Baboon Damage Working Group; Stream Flow Reduction Activity License Application Advisory Committee KwaZulu-Natal; Stream Flow Reduction Activity License Application Advisory Committee Mpumalanga; National Forest Research Forum; FSC: Forest Stewardship Council).

Table 1. Descriptive information for the most popular forums.

The interest group representing tree growers is the only actor that participated in the eight forums with the most participants. The Department of Agriculture, Forestry and Fisheries and the largest individual private landowning organisation in South Africa both participated in six forums. A scientific research and development organisation established through an Act of Parliament in 1945 and a state-owned corporation in control of the most productive government plantations participate in five forums each.

Civil society organisations are not frequent participants in the eight forums. The larger-scale and perhaps better-recognised groups, however, do participate in the Forest Stewardship Council, an international multi-stakeholder roundtable. Organisations representing rural communities and land reform beneficiaries – the ones most likely to experience the impact of plantation policies – are nearly non-existent in both the network and the forums. Our data shows that influential business interests, sometimes in conjunction with state interests, have a much wider representation, suggesting that the forums analysed here could well be failing to break up echo chambers. Participation in a single forum is both the median and the mode, although eleven organisations did not participate in any forums.

4.2 Results for the ERGMs

Model A in Table 2, below, presents our results using the information network as the dependent variable. Model B presents the results when the dependent variable is the information exchange ties between trusted partners. After comparing the AIC, BIC, log-likelihood, and the area under curve (AUC) and precision-recall (PR) measures for goodness-of-fit (see SI), we find that model A provides the best fit to our data. It supports all three of our hypotheses. First, it confirms that actors in the South African tree plantation policy network tend to exchange information with those with more similar beliefs to their own. Second, actors tend to exchange information with those with more reputational influence. Third, the more forums that a pair of actors co-participate in, the more likely they are to exchange information.

Table 2. Results for the ERGMs with standard errors in parentheses.

The parameter estimate for the belief homophily shows a positive and significant effect in model A, which thereby confirms the existence of an ‘echo’. The presence of a positive

GWESP term and a negative GWDSP term provide evidence that the 55 organisations involved in the contentious debate over tree plantations in South Africa are likely to follow the behavioural pattern of closing triads rather than leaving them open. The positive and significant GWESP term indicates that a pair of actors, of which at least one recognises another as an information exchange partner, is more likely than chance to have multiple shared partners. The negative and significant GWDSP indicates that information exchange behaviour that creates open triangles is unlikely to occur. These results indicate that actors are inclined to establish ‘chamber’ type structures, where actors exchange information within closed triads rather than with actors from across the network. This provides further evidence to support our first hypothesis: actors tend to exchange information with actors with beliefs that reinforce those of their own rather than with those whose views would challenge or undermine them.

Our second hypothesis tests if policy actors exchange information with those that have a reputation of being especially influential The parameter estimate for the reputational influence variable in Table 1 shows a positive and significant effect in model A, meaning that actors in the policy network are likely to form information exchange ties with those that have a reputation of being influential among the members of the network. Our 55 organisations do not recognise government departments with formal decision-making authority as information exchange partners more often than expected by chance.

We formulated our third hypothesis to investigate if the likelihood that policy actors exchange information with one another increases as they participate in more of the same policy forums. This hypothesis receives support in model A: co-participation in forums enables the knowledge acquisition aspect of cognitive learning. Because we factually build model A in

steps (see SI), and the inclusion of the forum co-participation variable improves the model fit, we may also draw that echo chambers are weaker among those that co-participate in forums relative to those that do not. The control term for number of forums that each actor participates is insignificant, indicating that those that are inclined to participate in more forums are not more likely than chance to create information exchange ties with more actors.

The negative and significant edge statistic confirms that the density of the network is relatively low and that the patterns of ties captured by the other terms in the models account for the bulk of the observed behaviour. The reciprocity term is significant, implying that actors recognise one another as information exchange partners. Inclusion of the co-operation network in the model improves fit (see SI), indicating that those that co-operate also tend to exchange information. Although the GWI term is positive and significant, its inclusion does not improve model fit much. Actors tend to preferentially attach to popular actors, which is occurring in parallel to the reputational influence effect, suggesting an overlap between these two effects.

Echo chambers and reputational influence continue to play a significant role in network formation when information exchange with trusted partners network is the dependent variable (model B). Organisations that participate in the same forums are more likely to develop trusted information exchange ties with one another than would occur by chance. This means that the interactions that occur in forums potentially enable not just the knowledge acquisition aspect of cognitive learning, but also the trust accumulation aspect of relational learning. However, comparing models A and B, the significance of forum co-participation is slightly lower in model B, and the coefficient drops from 0.32 to 0.11. More importantly, the median probability of an information exchange tie existing between a pair of actors that co-participate in at least one forum is substantially higher for the information exchange network (0.62) than for the trusted

information exchange network (0.32) (see SI). Forum co-participation, as opposed to belief homophily and reputational influence, is thus more likely to function for cognitive (knowledge gains) than relational learning (improved relations). The result for the institutional influence term in model B also differs to that in model A, indicating that being a government department is negatively associated with being recognised as a partner in the trusted information exchange network. In sum, we find evidence supporting all three hypotheses for both dependent variables.

We also conducted tests to see whether the results for the ERGMs are trustworthy by simulating 500 networks based on the model parameters to compare the observed network with (see SI). With some random variation, the distributions match the observed distributions of the same statistics satisfactorily for both models A and B.

Discussion and conclusions

Policy learning has been linked with different types of outcomes, including major policy change (Gerlak et al. 2018; Moyson and Scholten 2018). However, the questions about where policy actors obtain the information that informs their learning, and about which factors enable or impede learning, deserve equal attention. This paper contributed to this strand of literature by investigating how belief homophily, reputational influence, and co-participation in policy forums explain information exchange and trust building among actors in the South African tree plantation policy network.

Our approach entailed an examination of whether the actors exchanged information with those with policy beliefs similar to their own, with those that had a reputation of being influential, and with those that they encounter at forums organised to foster co-ordination. Our

ERGM results show that actors exchange information with those with similar beliefs to their own and that they tend to close information exchange triads rather than leaving them open, suggesting that structures representative of echo chambers play a significant role in network formation. Results indicate that reputational influence has a complementary effect on information exchange behaviour. Given the leeway that powerful actors possess in choosing with whom to communicate and what to share (Moeliono et al. 2014), this effect helps maintaining the existing power dynamics and potentially allows those in powerful positions to orchestrate the echo in the chamber. These two observations were consistent for both the information exchange network and the trusted information exchange network. However, forum co-participation had a stronger effect on the former.

Our descriptive analysis of participation in forums revealed that actors with rather dissimilar beliefs co-participate in the most popular forums. When we contrast these findings with those from the ERGMs, forums seem to attract organisations with dissimilar beliefs while also providing them with opportunities to exchange information and build trust accordingly. However, not all relevant actors, particularly those living with the effects of land use and land use change, are present or heard from in the forums. Actors representing business and state interests dominate many of the forums and the entire institutional system, meaning that their policy beliefs are quite likely to be known by others. Those who organise forums also tended to be aligned with these interests, placing them in a favourable structural position to influence who can participate, what gets discussed, what objectives are agreed on, and the range of policy options to be considered.

Our findings suggest that policy forums that foster co-ordination among policy actors from varying backgrounds principally work for the knowledge acquisition aspect of cognitive

learning (as knowledge gains). However, they also enable the trust accumulation aspect of relational learning. This means that the interactions that occur in forums potentially enable not just the knowledge acquisition aspect of cognitive learning, but also the trust accumulation aspect of relational learning. In the context of South African tree plantation policy, however, these findings occur in parallel to the existence of echo chambers. Although policy learning – acquisition, translation, and dissemination of information among actors with diverse bases of knowledge – is likely to occur in forums, forum co-participation does not necessarily break up the echo chambers fortified with the belief homophily effect, resource pooling effect, and tendencies to close triads. Echo chambers seem difficult to escape already in terms of sole information exchange behaviour, and even more so when interactions are more intensive and potentially more risky. Belief homophily and resource pooling are also likely to drive actors' behaviour in forums, especially in the most polarised ones, but co-participation will nevertheless increase the odds of two actors with dissimilar policy beliefs engaging one another. In turn, we suspect the tendency to form echo chambers to be stronger among those that do not participate in forums (relative to those that do), the extent to which, however, we are unable to determine with our data.

In this paper, we have tested well-established hypotheses concerning policy actors' behaviour, but in a novel and turbulent policy context and in relation to two different types of learning. We used ERGMs to test our three hypotheses simultaneously, which remains a novel approach in research on policy learning. A similar approach with slightly different parametrisation of the ERGMs was recently applied by Wagner and Ylä-Anttila (2018), who investigated the Irish climate policy network and found that actors tended to rely on policy advice from those with which they shared similar policy beliefs. In contrast to our findings, however, forum co-participation did not increase the likelihood of pairs of actors forming

network ties. The behavioural dynamics that we observe in the networks analysed here resemble those identified by Fischer, Ingold, and Ivanova (2017) and Leifeld and Schneider (2012). Jasny et al. (2018), however, found that echo chambers could rapidly reorganise around specific policy instruments – in this case, around the Obama Administration's Clean Power Plan – and amplify convergence among policy actors. Following the recently enacted laws concerning the "expropriation of land without compensation" and the carbon tax, similar reorganisation might well occur in the South Africa tree plantation policy domain.

Our analysis arrives with some notable limitations. First, our research design only elicited data on the exchange of information, which means that we can distinguish neither between senders and receivers of information nor between political, technical, or scientific information. Such dimensions of information exchange, however, have been studied elsewhere, including by Fischer, Ingold, and Ivanova (2017). Our focus was on understanding what fosters and impedes different types of learning based on information exchange. Second, our operationalisation of policy learning is relatively narrow. It relies on recognitions of information exchange partners and self-reported trust of other organisations. This operationalisation, however, allowed us to measure the interactions and beliefs among the actors, and use statistical inference in their analysis. Third, social interactions occur on an evolutionary trajectory that shift between states of co-operation and defection (Imhof, Fudenberg, and Nowak 2005). Redundancy and defection are inherent features of complex institutional systems, which is important to consider when assessing the goodness-of-fit of our models. Due to the nature of cross-sectional data, we were unable to investigate whether actors' beliefs converged after meeting those that think differently about the planting of alien trees in drying South Africa.

The literature remains rather divided over the benefits of organising forums to promote co-ordination across the different sectors of society. Hamilton and Lubell (2018) find that co-participation in forums positively contributes to co-operative behaviour in an Eastern African transboundary setting. Relying on the general notion of homophily, they suggest that forums at lower spatial levels are more likely to attract those that are spatially closer to one another and know the context, culture, and problems well. Herzog and Ingold (2019) support the view that forum co-participation contributes to co-operation in another transboundary setting in the Rhine catchment area. In this context, sharing an understanding of the degree of threat the common-pool resource is facing facilitated co-operation. Researchers have also highlighted the contributions of leadership and facilitation (e.g. small working groups) to forum success (Levesque et al. 2017; Leys and Vanclay 2011; Ospina and Saz-Carranza 2010).

Maag and Fischer (2018) and Reed et al. (2018) have recently opened new chapters in the understanding of the dynamics occurring in forums and the factors that contribute to their success. This occurs in parallel with recent advancements in the understanding of the behaviour of policy actors in complex institutional systems with multiple interdependent forums (Berardo and Lubell 2019; Mewhirter and Berardo 2019). Testing of related hypotheses, both well and less established ones, in different policy contexts, and in the context of different intensities of interactions, warrants further attention. The use of longitudinal data would help clarify whether there is an order of precedence between the echo (belief homophily) and the chamber (triad closure) in the formation and dissolution of echo chambers, and for the broader significance of echo chambers for policy success or failure.

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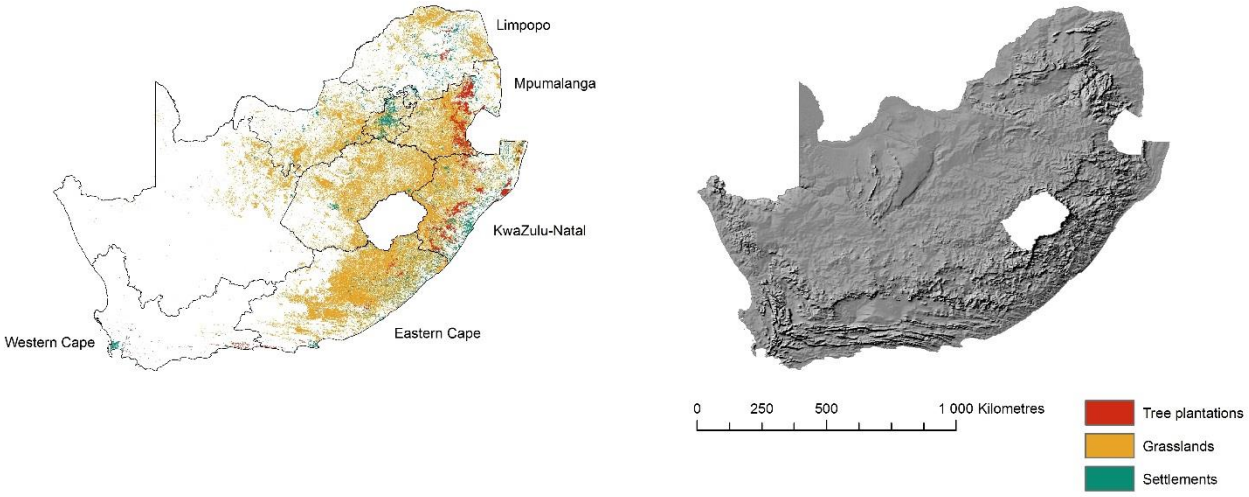

Figure 1. Tree plantations in South Africa (own elaboration based on DEA, 2014).

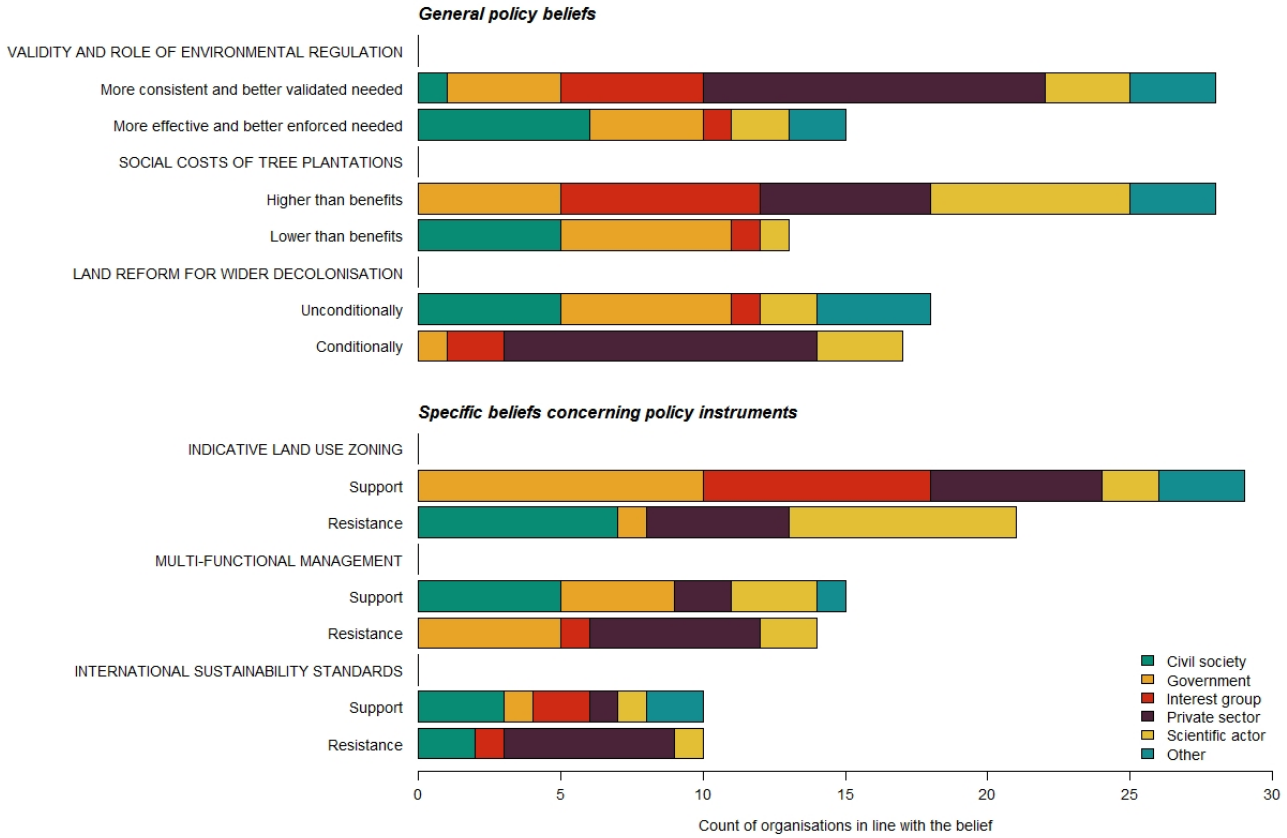

Figure 2. Polarisation over salient policy beliefs by actor type.

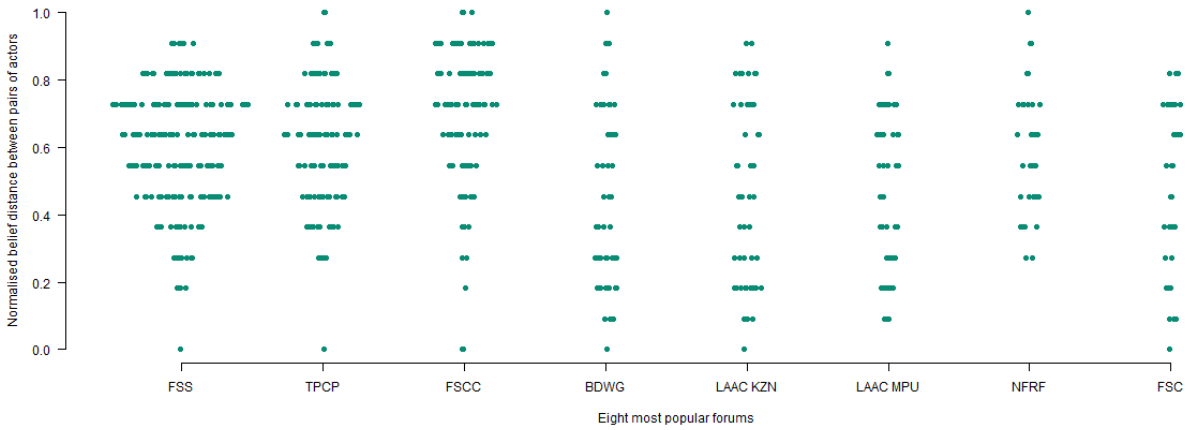

Figure 3. Normalised belief distance between pairs of actors in the most popular forums (FSS: Forest Science Symposium; TPCP: Tree Protection Co-operative Programme; FSCC: Forest Sector Charter Council; BDWG: Baboon Damage Working Group; Stream Flow Reduction Activity License Application Advisory Committee KwaZulu-Natal; Stream Flow Reduction Activity License Application Advisory Committee Mpumalanga; National Forest Research Forum; FSC: Forest Stewardship Council).

Table 1. Descriptive information for the most popular forums.

Acronym	Name	Organiser	Spatial scale	Affiliation diversity							Belief distance				
				N	CS	GO	IG	PS	SC	OT	Min	Max	Mean	SD	IQR
FSS	Forest Science Symposium	Scientific actor	National	21	0	1	1	10	9	0	0.00	0.91	0.60	0.17	0.27
TPCP	Tree Protection Co-operative Programme	Scientific actor	National	16	0	2	1	10	3	0	0.00	1.00	0.62	0.17	0.27
FSCC	Forest Sector Charter Council	Government	National	15	0	7	8	0	0	0	0.00	1.00	0.70	0.20	0.18
BDWG	Baboon Damage Working Group	Private sector	Provincial: Mpumalanga	11	3	2	1	5	0	0	0.00	1.00	0.46	0.26	0.41
LAAC KZN	Stream Flow Reduction Activity License Application Advisory Committee	Government	Provincial: KwaZulu-Natal	11	2	5	1	2	1	0	0.00	0.91	0.48	0.26	0.50
LAAC MPU	Stream Flow Reduction Activity License Application Advisory Committee	Government	Provincial: Mpumalanga	11	2	4	1	3	1	0	0.09	0.91	0.47	0.23	0.36
NFRF	National Forest Research Forum	Government	National	10	0	2	1	0	6	1	0.27	1.00	0.58	0.18	0.27
FSC	Forest Stewardship Council	Civil society	International	9	3	0	1	4	1	0	0.00	0.82	0.48	0.25	0.45

CS=Civil society, GO=Government, IG=Interest group, PS=Private sector, SC=Scientific actor, OT=Other

Table 2. Results for the ERGMs with standard errors in parentheses.

	Model A **Information exchange network** *Information acquisition aspect of cognitive learning* *Density = 0.40*	**Model B** **Trusted information exchange network** *Trust accumulation aspect of relational learning* *Density = 0.27*
Edges	-4.28 (0.47) ***	-3.12 (0.29) ***
Exogenous variables		
Belief homophily (H1)	0.08 (0.02) ***	0.09 (0.02) ***
Reputational influence (H2)	0.07 (0.01) ***	0.04 (0.01) ***
Institutional influence	-0.19 (0.14)	-0.57 (0.12) ***
Forum co-participation (H3)	0.30 (0.05) ***	0.10 (0.04) *
Forums participated	0.01 (0.01)	0.00 (0.01)
Co-operation	1.25 (0.10) ***	1.19 (0.10) ***
Endogenous terms		
Reciprocity	1.28 (0.13) ***	0.59 (0.14) ***
GWESP (d = 1.0)	0.74 (0.15) ***	0.50 (0.07) ***
GWDSP (d = 1.0)	-0.11 (0.01) ***	-0.13 (0.01) ***
GWI(d = 1.0)	3.72 (1.52) *	1.31 (0.55) *
Goodness-of-fit		
AIC	3043	2616
BIC	3109	2682
Log-likelihood	-1511	-1297
AUC-PR	0.73	0.58
AUC-PR null	0.40	0.29