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ORIGINAL ARTICLE

Comparing Online and Offline Political Support

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Abstract
Do politicians carry on their interpersonal relations online? We examine how online political support compares to offline support. We overlay two data sets on political support among members of the Swiss National Council to estimate the explanatory power of online endorsements on offline cosponsorship signatures among members, using a gHypEG network regression model. Whereas offline support behavior is driven by a broad range of factors, such as network and homophily effects, endorsement is less diverse. Our findings show that online endorsement is predominantly driven by partisanship and does not mirror the richness found in offline support behavior.

Zusammenfassung
Inwiefern führen Politiker:innen ihre zwischenmenschlichen Beziehungen online weiter? Wir untersuchen, wie sich politische Unterstützung online mit offline Unterstützung vergleicht. Hierzu überlagern wir zwei Datensätze über Bekundungen politischen Beistandes zwischen Mitgliedern des Schweizer Nationalrats. Anschliessend schätzen wir die Erklärungskraft, die online Unterstützung über offline Miträgerschaft in der Form von Unterschriften auf politischen Vorstössen (sog.Cosponsorship)hat.DiequantitativeSchätzungführen wir mithilfe eines gHypEG Netzwerkregressionsmodels durch. Wobei das Unterstützungsverhalten offline durch

breitgefächerte Faktoren gesteuert wird, wie durch Homophilie- und Netzwerkeffekte, sind in den online Daten diese Faktoren weniger prävelent. Unsere Resultate zeigen auf, dass online Unterstützung mehrheitlich durch Parteimitgliedschaft gesteuert wird und somit die Diversität des Verhaltens offline nicht widerspiegelt.

Résumé

Les politiciens étendent-ils leurs relations interpersonnelles en ligne? Nous analysons comment le soutien politique en ligne se compare au soutien hors ligne. Pour cela, nous superposons deux sets de données sur le soutien politique parmi les membres du Conseil national suisse. Ceci a pour but d'estimer le pouvoir explicatif du soutien en ligne par rapport à celui hors ligne sous forme de signature de coparrainage (cosponsorship). L'estimation se fait en employant un modèle gHypEG, une régression sur base d'ensembles de réseaux. Alors que le comportement de soutien hors ligne est guidé par de nombreux facteurs comme des effets d'homophilie ou de réseaux, le soutien en ligne est moins diversifié. Nos résultats démontrent que le soutien en ligne est majoritairement guidé par partisanerie et ne reflète donc pas la richesse du comportement hors ligne.

KEYWORDS

political support, legislative politics, cosponsorship, legislative networks, online and offline behavior

INTRODUCTION

Data from online political interactions are more and more used to study and to explain real-world politics. This development is mainly driven by the availability of *data* from social media platforms (Grimmer, 2015) and the increasing number of *tools* to model web-based data (e.g., Barberá, 2015; Beauchamp, 2017; Garcia et al., 2012). For instance, data from online social media platforms such as the microblogging platform *Twitter* have been used to study patterns in alliance formation among politicans (Cherepnalkoski & Mozetič, 2016), political ideology (Bond & Messing, 2015), mobilization (Alvarez et al., 2015), voting outcomes (DiGrazia et al., 2013) or issue attention (Barberá et al., 2019).

These studies are often generalized into real-world political behavior, presupposing that a clear-cut comparison between online and offline politics is justified. But to what extent can online political behavior be compared to offline behavior?

We try to shed light on this question by comparing online and offline political support among members of the Swiss parliament (MPs). For this comparison we use data about their cosponsorship support in parliament and their endorsement clicks on the Swiss social media platform *Politnetz*.

Online political endorsement can be seen as a positive exchange among politicians on social media portals, leaving positive comments on another politician's post or tagging collaboration partners in social media appearances. We analyze data from the online networking and debate platform *Politnetz*, which was founded in 2009 to provide politicians and the general public with a forum for political discussions and to foster transparency in politics. The portal was widely used until 2016 and includes over 3,000 politicians (local, cantonal/state and national level) (Garcia et al., 2015). Apart from discussing political issues, users of *Politnetz* were given a chance to openly demonstrate their support for other politicians by clicking the endorsement button on the politician's profile page. Users also present their list of supportees on their own profile page.

Offline political support comes in many forms, such as praising another politician in a speech, exchanging information, collaborating on a project or hosting events together. Our focus is on *cosponsorship* as a widely studied signature of political support among MPs (e.g., Bratton & Rouse, 2011; Campbell, 1982; Fowler, 2006; Kessler & Krehbiel, 1996). Cosponsorship signatures reflect low-cost signals of support among MPs and thus compare well to low-cost actions on social media platforms. MPs co-sign bills[1] to show their preferences for a particular political issue. Apart from internal signaling, we also know that cosponsorship support mirrors a rich set of personal relations among MPs. Alternative motivations to cosponsor a proposal are personal ties (e.g., friendship or familial) among the sponsor and cosponsor of a bill, notions of reciprocity or favor trading (Brandenberger, 2018), coalition formation or group dynamics, such as homophily or party cohesion (Bratton & Rouse, 2011; Craig et al., 2015; Tam Cho & Fowler, 2010).

We analyze cosponsorship data from two legislative periods (2007–2015) of the Swiss parliament to match the timespan of our online data. Over the course of these two legislative periods, 312 MPs served in the National Council and exchanged over 91,000 cosponsorship signatures on bills. To operationalize cosponsorship support among MPs, we have chosen a *network representation*. Each node in this network represents an MP and directed edges between MPs represent (repeated) cosponsorship support from one MP to another. This results in a multi-edge network $\mathcal{G}$, where edge counts range form zero (no support between two MPs) to the maximum number of bills an MP proposed to parliament. For instance, if MP a proposed 12 bills, other MPs i can support a 0–12 times.

The existence of repeated interactions is often left out in the analysis of cosponsorship networks (e.g., Fischer et al., 2019). Instead, the network is simplified to a binary version which only distinguishes *whether or not* two MPs have supported another, but *not how much*. This introduces a bias because one-time support counts the same as repeated support over a long time. To avoid such biases, we analyze the multi-edge network as is.

To compare online and offline political support among MPs, we use a gHypEG regression model (Brandenberger et al., 2019; Casiraghi, 2017). This is an inferential network model that allows for unbiased estimates of parameters when the independence assumption is violated (Casiraghi, 2019; Casiraghi et al., 2016, 2017). It is designed for multi-edge networks.

Our results indicate a weak association between online and offline support behavior. We show that party alliances mainly drive online endorsement. Whereas cosponsorship support is more rich in nature, showing significant effects of reciprocity dynamics and homophily traits, online endorsement is more simplistic. Our results call into question the growing number of

[1]The term *bill* is used synonymously for any form of personal parliamentary bill, including interpellations, parliamentary motions or postulates.

empirical studies that treat online data in the same manner as offline data and demand future comparisons of the sort.

This article is structured as follows: First, we discuss online and offline political support behavior, then we describe the two data sets analyzed, as well as the gHypEG regression model. Results are presented for four different models, technical details are given in the supplementary material. In our concluding remarks, we discuss the insights obtained from our analysis.

POLITICAL SUPPORT AMONG MEMBERS OF PARLIAMENT

Members of parliament (MPs) know different ways of supporting or endorsing each other. They can lend votes to bills or proposed changes thereof, cosponsor newly introduced bills, co-vote, support each other in speeches, or host press events together (see, for instance Burstein et al., 2005; Desmarais et al., 2015; Peoples, 2008; Talbert & Potoski, 2002; Wilson & Young, 1997). By building alliances and exchanging support, MPs increase their visibility and their power to influence the decision-making process in their favor. The influenced decisions can then be communicated to their constituents, increasing their probability of re-election. As such, gathering and bestowing social support can be seen as a key mechanism guiding MPs' daily business.

Every collaboration or instance of support can increase trust between MPs (e.g., Friedkin, 2004; Melamed & Simpson, 2016), resulting in complex interdependencies among MPs. These interdependencies can be described as interwoven webs among MPs (Granovetter, 1985) or social networks of MPs with distinct community structures (Fowler, 2006; Kirkland & Gross, 2014).

These instances of support among MPs are not limited to parliamentary actions. Outside parliament, MPs create bonds, for instance, through shared memberships in organizations, shared board memberships, or through personal interactions (Desmarais et al., 2015; Fischer et al., 2019). Moreover, with the increasing importance of online interactions on political debates and political vote-seeking, online political endorsement can help foster bonds between MPs that later result in parliamentary alliances.

While studies on *online* political behavior are abundant, little is known about the strategies MPs use to influence decision-making processes in the real world with online campaigns and interactions (Cook, 2016). An open question remains of *how political behavior online differs from behavior offline*. How do MPs interact and endorse each other online, and how much of this online behavior reflects the complex interdependencies built and groomed in the real world, i.e., offline? We address this question by comparing online and offline political support among Swiss members of parliament.

Offline political support

One of the most widely studied forms of legislative support is cosponsorship signatures (e.g., Baller, 2017; Bratton & Rouse, 2011; Campbell, 1982; Fowler, 2006; Kessler & Krehbiel, 1996; Kirkland, 2011). These low-cost, fast actions encode support among MPs for their proposed pieces of legislation. This support can either be directed at the content of a bill, which an MP finds worthy of support, or directed at the sponsor of a bill, with whom the cosponsor shares personal or strategic ties. Alternatively, during the preparation of a legislative bill, sponsors often approach other MPs to sway them to their cause, targeting MPs they trust or whose interest in the issue is known to the sponsor. In 1919, for instance, MP Winiger declared at the start of his speech: “Die Motion Usteri ist auch von einigen meiner politischen Freunde und vom

Sprechenden unterzeichnet worden."[2], revealing the personal nature of cosponsorship signatures among MPs.

In the Swiss National Council, members can cosponsor so-called personal bills (dt. persönliche Geschäfte), such as motions, postulates and interpellations. Whilst the number of cosponsorship signatures on a legislative proposal does not guarantee its success (for empirical evidence or lack thereof see Burstein et al., 2005; Krehbiel, 1995; Sciarini et al., 2021; Wilson & Young, 1997; Woon, 2008), they are widely considered important signals among MPs (both for sponsors and cosponsors) (Mayhew, 1974). This signaling can be for the benefit of revealing your position to other MPs or to signal an MP's interest in an issue to their constituents. Kessler and Krehbiel (1996) addressed the question of whether legislative cosponsorship is driven by i) intralegislative signaling (Wilson & Young, 1997) or ii) extralegislative position taking (Schiller, 1995) and give empirical evidence that cosponsorship is driven by intralegislative signaling.

Apart from intralegislative signaling, cosponsorship support is guided by social closure where MPs close social gaps by supporting the friends of their friends (Burt & Knez, 1995; Coleman, 1990; Granovetter, 1973; Simmel, 1908 [1950]). This form of social interaction helps build bridges to different parliamentary clusters (or groups) (Cranmer & Desmarais, 2011; Kirkland, 2011; Kirkland & Gross, 2014; Talbert & Potoski, 2002; Wilson & Young, 1997). Another important determinant of how MPs support each other is reciprocity—the tendency to repay received favors (Brandenberger, 2018; Emerson, 1976; Gouldner, 1960). Furthermore, Fischer et al. (2019) show that Swiss MPs are more likely to cosponsor bills if they share interest group ties with the sponsor of the bill. Multiple quantitative studies have shown that homophily plays an important role, indicating that MPs cosponsor bills of similar MPs more readily than MPs with whom they do not share traits (Bratton & Rouse, 2011; Craig et al., 2015; Tam Cho & Fowler, 2010). Party, race, gender, and state homophily are amongst the most important correlates with cosponsorship activities. These motivations to cosponsor a bill are by no means universal nor do they apply to all members equally. For instance, Brandenberger (2018) shows that for the 113th U.S. House of Representatives, favor trading is more common among Republican members.

Thus, legislative support has been shown to encompass a broad variety of motivations, ranging from individual ideological preferences to signaling and group dynamics. The question remains whether online political endorsement among the political elite i) is motivated by internal or external factors and ii) likewise guided by a wide variety of individual and network effects.

Online political endorsement on social media platforms

Political actors have expanded the political arena to online platforms, where they debate current events, comment on campaigns, or present themselves and their political positions. This raises the question of whether the online behavior of political elites differs from behavior offline. The question is relevant because online data is more easily accessible and is currently widely used to study the behavior of politicians and political actors. However, this also poses a problem because the external validity of political actors' online behavior data may not be a given.

Two important theoretical questions need to be distinguished in the study of the external validity of online data. First, the question on the distinction between online and offline behavior needs to be addressed. Do politicians and political actors make use of the same bargaining strategies in an online setting? Do they use their online interactions to maintain

[2]Amtliches Bulletin, 1919, document Nr. 2002873, page 8, right column.

and strengthen already existing alliances? Evidence for answering these questions can be found in the overlap between online and offline support. A large divergence of supportees online and offline can indicate a mismatch in strategic interests or a difference in the costs of maintaining alliances online vs. offline. Second, the question regarding the influence of online behavior on real world (offline) politics can be raised. Here, one can ask whether online communications or interactions lead to new alliances or a shift in positions. While the second question is both theoretically and methodologically more challenging (and has not been tackled in empirical studies today), the first has received some (limited) attention, with a few studies directly linking online and offline political behavior to study potential correlations among the two.

Cook (2016) studies three forms of *Twitter* communications and compares explanatory factors to factors driving congressional co-voting and cosponsorship in the U.S. Senate and the Maine State Legislature. For each pair of MPs, he examines whether direct mentions between the two MPs, their number of shared mentions, or the number of co-mentions by others are guided by party homophily, geographic, and other forms of homophily and shared committee service. He finds that party homophily is weaker in online social behavior than in legislative behavior, both for federal and state legislators. Regrettably, Cook (2016) does not match online and offline behavior in a statistical model to examine the interplay between the two behaviors. Furthermore, even though Cook (2016) uses a network inference model (QAP regression), he does not control for higher order effects on pairs (i.e., triadic closure), which potentially bias his results (Cranmer & Desmarais, 2011). This makes it impossible to judge whether the weaker party adherence exhibited online by legislators is due to the nature of online communication or due to the way the effect is measured. It is also impossible to gauge whether cross-party online communications have an effect on offline behavior.

Cherepnalkoski and Mozetič (2016) examine the re-tweeting behavior of members of the European Parliament over one year. They use a cluster analysis to divide the *Twitter* network into communities and find that offline political groups in the European Parliament are mirrored in these online communities. They assess this matching between offline political groups and re-tweet communities using precision and recall measures for each European MP. Cherepnalkoski et al. (2016) extended the previous study to examine whether re-tweeting behavior matches co-voting patterns among the same set of European MPs. Specifically, they use Exponential Random Graph modeling (ERGM) to examine whether re-tweeting is correlated with roll-call voting. Since ERGMs were developed for binary networks (i.e., networks where the links or edges between nodes are either present (=1) or absent (=0)), they disaggregate each vote ($N = 2{,}535$) into separate co-voting networks and study the correlation between each co-voting incident and online endorsement via re-tweeting activities on *Twitter*. While their ERGMs report positive, significant effects for the correlation between re-tweeting and co-voting, their effect sizes are near zero, indicating only a weak correlation between the two.[3]

These previous studies do not give a clear answer as to the question of whether or not politicians' online behavior systematically differs from offline behavior. They cannot be used to validate the use of online data as a proxy for offline data. While the studies show that some positive correlation between online and offline behavior can be expected, important open questions remain: Can online political endorsement be seen as a form of extra-legislative signaling, bringing an additional dimension to explaining offline support? Is online political endorsement as complex as offline support, i.e., does it reflect the interdependencies among MPs to form triads, reciprocate favors, or group together based on similar attributes? This

[3]Cherepnalkoski et al. (2016) do not report the control variables they used in their ERGMs in detail, making it difficult to assess whether their models are well-specified and therefore unbiased due to omitted variables.

paper tackles these open questions. We are particularly interested in dissecting the different factors that drive offline political support behavior among MPs and examining whether online political endorsement differs from offline support.

DATA AND METHODS

Data

Our study uses two different data sets to compare online and offline support among members (MPs) of the Swiss National Council, the lower chamber of the Swiss parliament.[4]

Offline Data

Our offline data set contains information about cosponsorship among MPs for two consecutive legislative periods from December 2007 to 2015 in order to overlap with our online data. During this period 11 different parties (see supplementary material for a list of members and their party affiliation) were represented in parliament.[5] From December 2007 to 2015, 321 MP served in the National Council (200 per session, with some overlap between sessions).

In total, the 321 MPs cosponsored each other 91,225 times, with the average MP cosponsoring 284.2 bills (median = 174, sd = 323.3) over the two legislative periods. The effort involved in cosponsoring a bill in parliament can range from co-writing the bill (i.e., using significant time and resources in the bill drafting stage) to signing a bill on the way to the next parliamentary session (i.e., spending 5 seconds on a signature).

Online Data

Our online data set contains information about endorsement clicks among users of *Politnetz*. This online platform for political debate and networking was active from 2009 to 2016, to foster the political exchange between regular citizens and politicians in Switzerland. On the platform, users (politicians and citizens) could (i) publish posts on political issues and '*comment*' on posts of other users; (ii) '*like*' the posts of others, and (iii) publicly declare support for a politician by pressing an '*endorse*'-button on the politician's profile page (Garcia et al., 2015).

The effort for an 'endorse'-click on social media is comparable to the effort for a cosponsorship signature. It can range from maintaining a strong social media relationship to identifying an ally in short time and clicking the 'endorse'-button. The platform does not suggest to support certain politicians to the users based on their previous support actions, making '*endorse*' clicks on *Politnetz* free from algorithmic manipulations (as opposed to *Twitter*, for example).

Overall, 3,030 users were active on *Politnetz* between 2009 and 2016 and shared 21,347 endorsements. After matching these data with the cosponsorship data set, we identified 163 MPs

[4]Replication Materials: The data, code, and any additional materials required to replicate all analyses in this article are available on our ZENODO repository https://doi.org/10.5281/zenodo.6372825.

[5]It should be noted that the *Free Democratic Party* (FDP) merged with *The Liberals* at the beginning of 2009. We treat them as one party (i.e., as *FDP.The Liberals* as they are known from 2009 onwards) during our observation period.

from the Swiss parliament who were active on *Politnetz* between 2009 and 2016. We focus our analysis on these 163 MPs.

By focusing on 163 MPs, we involuntarily subsample our data. In order to alleviate the possible bias caused by subsampling, we take two countermeasures: (1) Rather than looking only at direct support links among MPs, we examine how similar the online endorsement behavior of MPs are. We use the full Politnetz dataset, involving 3,030 users, to calculate endorsement similarities between MPs. This gives us a more robust measure of online endorsement behavior among MPs. (2) We calculate the in- and outgoing shared partner statistics of the 163 MPs accounting for support signatures issued to or from any of the 321 total members of parliament. Thus, considering the two legislative periods, we do *not reduce* this endogenous statistic to only cosponsorship signatures among the 163 MPs. We detail these two countermeasures below when describing the operationalization of covariates.

Method

We are interested in how offline cosponsorship support can be explained by online endorsement among MPs. Particularly, we try to estimate how much of the variance in cosponsorship signatures can be explained by online endorsements. Statistical regression models allow to perform such analysis, by regressing offline cosponsorship support (our dependent variable) against online endorsement. Pursuing this approach, we face two distinct problems: First, political support among MPs is an inherently social act. Therefore, we need a network representation to reflect the fact that cosponsorship signatures (as well as online endorsements) depend on another (Cranmer & Desmarais, 2011; Fowler, 2006). This causes the second problem, in that conventional regression models should not be performed on network data, as they yield unreliable results. The intrinsic dependencies between observations in our data violate the fundamental i.i.d. assumption of these models. This leads to erroneous estimates of the model's standard errors (Cranmer & Desmarais, 2011).

To avoid this known problem, in this article we use an *inferential network model*. Inferential network models first define a baseline random graph model that generates edges between all different nodes uniformly. Then, they incorporate covariates with different weights to increase the probability of creating some edges instead of others. Finally, fitting these weights, i.e., the model parameters, to the observed data allows to estimate the explanatory power carried by these covariates.

We operationalize our cosponsorship network as a directed multi-edge graph $\mathcal{G} = (V, E)$ with $V = 163$ vertices and $E = 26{,}559$ edges. This reflects one MP i supporting another MP j by signing bills sponsored by the latter. The vertices, or nodes in the network, represent the MPs, the edges their cosponsorship signatures. The matrix $\boldsymbol{A}$ denotes the adjacency matrix of $\mathcal{G}$, whose entries $A_{ij} \in \mathbb{N}_0$ correspond to the number of times MP i signed a bill sponsored by MP j. Because cosponsorship is directed from i to j, the adjacency matrix $\boldsymbol{A}$ defines a directed graph, with A_{ij} possibly different from A_{ji}.

We first define a baseline model for offline cosponsorship support. Under this baseline, cosponsorship signatures between any pair of MPs are assumed to be equiprobable. The maximum number of cosponsorship signatures i can give to j is the number of bills n_j that j has sponsored. This fact constrains the maximum number of possible edges that can exist between any given pair of MPs. Thus, we can see such a baseline network model as the uniform sampling of E signatures from the possible cosponsorships $\Xi = \left\{ \Xi_{i,j} = n_j \right\}_{i,j \in V}$ between all MP pairs i, j. The matrix Ξ allows to represent the possible signatures for all pairs in a compact form.

Next, we extend this baseline model to introduce explanatory factors in the form of sampling weights for different edges that bias the uniform edge generating process. The main explanatory factor we are interested in is *online endorsement* (OE) and its weight θ_{OE} on cosponsorship.

It reflects how much the probability of observing a signature between MPs i and j is biased by the fact that i has endorsed j online. To quantify the weight θ_{OE} of such a categorical explanatory factor $h_{ij}^{(OE)}$, or covariate, we employ the generalized hypergeometric ensemble of random graphs (gHypEG, Casiraghi & Nanumyan, 2021).

Similar to the matrix Ξ, we write the covariate associated with online endorsement in matrix form: $\boldsymbol{h}^{(OE)} = \left\{ h_{i,j}^{(OE)} \right\}_{i,j \in V}$. This is the *independent variable* of our inferential network model. According to the gHypEG, the probability of observing the graph $\mathcal{G}$ with adjacency matrix $\boldsymbol{A}$ depends on both the matrix Ξ and the matrix $\boldsymbol{h}^{(OE)}$ as follows:

$$P\left(\mathrm{A} | \Xi, \theta_{OE}, \boldsymbol{h}^{(OE)}\right) = \prod_{ij} \binom{\Xi_{ij}}{A_{ij}} \int_0^1 \prod_{ij} \left(1 - \exp\left\{ \frac{\left(h_{ij}^{(OE)}\right)^{\theta_{OE}}}{S} \log z \right\}\right)^{A_{ij}} dz, \tag{1}$$

where $S = \sum_{ij} h_{ij}^{(OE)\theta_{OE}} \left(\Xi_{ij} - A_{ij}\right)$. The weight θ_{OE} of the covariate $\boldsymbol{h}^{(OE)}$ is estimated by means of maximum likelihood (Casiraghi, 2017). Thanks to gHypEG, we are now able to model repeated interactions such as cosponsorship signatures. This is in stark contrast with other inferential network models that require reducing the interaction counts to a binary variable, usually by introducing a cut-off threshold.

In the model given by Equation (1), θ_{OE} represents the log-odds of observing a cosponsorship signature between any directed pair of MPs for which an online endorsement has been observed, against a directed pair for which no endorsement has been observed.[6] Thus, estimating θ_{OE} allows to quantify how much offline cosponsorship support is explained by online endorsement.

To get a reliable estimate of θ_{OE}, though, we need to account also for known effects that drive offline cosponsorship support. These could mask the main effect we are interested in (Spector & Brannick, 2011). To include these known effects into the model, in the next section we specify endogenous $\left\{ h_{ij}^{(e_l)} \right\}_l$ and exogenous $\left\{ h_{ij}^{(o_l)} \right\}_l$ *control variables*. Ultimately, this means that the relative sampling weight ω_{ij} of a cosponsorship signature between i and j depends not only on the online endorsement $h_{ij}^{(OE)}$, but also on these additional effects. The odds of observing a signature between a pair i, j of MPs instead of a second pair k, l are therefore given by $\omega_{ij} / \omega_{kl}$. In the simple case described above, we have:

$$\log \omega_{ij} = \theta_{OE} \log h_{ij}^{(OE)}, \tag{2}$$

i.e., the log-odds of observing a cosponsorship signature are proportional only to the covariate $h_{ij}^{(OE)}$ representing online endorsement. In the general case, we extend the log-odds such that they are proportional to all covariates:

$$\log\left(\omega_{ij}\right) = \left[\overbrace{\theta_{OE} \log h_{ij}^{(OE)}}^{\text{online endorsement}} + \overbrace{\underbrace{\theta_{e_1} \log h_{ij}^{(e_1)} + \ldots + \theta_{e_n} \log h_{ij}^{(e_n)}}_{\text{endogenous effects}} + \underbrace{\theta_{o_1} \log h_{ij}^{(o_1)} + \ldots + \theta_{o_m} \log h_{ij}^{(o_m)}}_{\text{exogenous effects}}}^{\text{control variables}} \right] \tag{3}$$

Eventually, we replace $\left(h_{ij}^{(OE)}\right)^{\theta_{OE}}$ in Equation (1) with ω_{ij}, to obtain the full inferential network model (Casiraghi, 2017).

[6]Assuming the two pairs have identical Ξ values.

Similar to a regular statistical regression model, we estimate simultaneously all parameters θ_x for each of the covariates $\boldsymbol{h}^{(x)}$. This is achieved using a numerical Maximum Likelihood Estimation (MLE) (Casiraghi, 2017). Specifically, we use the ghypernet package (Casiraghi & Nanumyan, 2020) in the statistical environment R (R Core Team, 2020) to estimate the gHypEG inferential model.

Operationalization of Covariates

Independent Variable: Online endorsement

We operationalize direct online endorsement in the form of a matrix $\boldsymbol{h}^{(OE)}$ representing a categorical variable. Entries $h_{ij}^{(OE)}$ are either 1 when no online endorsement between two MPs has been recorded or e if MP i supported MP j online. When we plug this operationalization in Equation (3), the log-odds of observing a signature between a pair i, j with online endorsement against a pair k, l without online endorsement is exactly θ_{OE} as required:

$$\log \frac{\omega_{ij}}{\omega_{kl}} = \log \omega_{ij} - \log \omega_{kl} = \theta_{OE} \log h_{ij}^{(OE)} - \theta_{OE} \log h_{kl}^{(OE)} = \theta_{OE} \tag{4}$$

Eventually, we have to avoid biases resulting from our sample's restriction to 163 MPs. Therefore, we also generate a similarity matrix for the online endorsement behavior. This similarity matrix measures the overlap between the lists of supportees for both MPs i and j. For each pair i, j we measure the percentage of i's supportees S_i that is shared by j:

$$h_{ij}^{(OE\text{sim})} = \frac{S_i \cap S_j}{S_i} \tag{5}$$

S_i and S_j refer to the set of politicians that MPs i and j endorse online (i.e., $S_i = i$'s supportees). $h_{ij}^{(OE\text{sim})}$ results in a directed similarity measure between MPs i and j, that scales from 0, most dissimilar, to 1, most similar. A value of 1 indicates that both MPs i and j endorse the exact same politicians online. For example, if i supports five politicians (a, b, c, d, and e) and j supports 3 politicians (a, f, g), then $h_{ij}^{(OE\text{sim})} = 0.2$ and $h_{ji}^{(OE\text{sim})} = 0.33$. By doing so, we ensure that $h_{ij}^{(OE\text{sim})}$ accounts for the number of endorsement clicks an MP gives.[7]

Control Variables

We control for several endogenous and exogenous effects in line with previous studies on political support. Cosponsorship dynamics have been shown to be guided by endogenous effects, such as reciprocity dynamics (or favor trading), closure, and homophily effects. We add control variables to our model in order to understand how the correlation between online and offline support is offset or mitigated through explanatory factors. We calculate the relevant endogenous network effects on the full cosponsorship network, i.e., with 321 MPs and 91,225 cosponsorship signatures. As for exogenous effects, we use an MP's party

[7]As a sensitivity check, we also operationalized similar online behavior using the Jaccard similarity. This measure is not affected by the number of politicians an MP supports on *Politnetz*. As results did not vary between the two measures, we perform our primary analysis with the simpler similarity measure presented above. We report our operationalization of the Jaccard similarity, as well as the results in the supplementary materials.

membership, the canton they represent as well as their gender to check for homophily traits between pairs of MPs.

Our first control is for reciprocity. Reciprocity represents the tendency of MPs to trade favors. For each pair i, j of MPs, we count how often sponsors j reciprocate support they received form i on previous bills. Second, we control for social closure among MPs. Here, we count how many shared partners a pair of MPs have in common (either both supporting said partner or said partner supporting both). Third, we control for homophily effects among pairs of MPs. We check for age difference, gender homophily, party homophily and cantonal homophily as well as whether or not the pair of MPs sat on the same committee, as previous research on political support have done. Fourth, we control for the difference in the number of supportees two MPs have online, to proxy online activity. Lastly, we include a set of correcting factors that provide a baseline for those pairs for which a given covariate provides no information. For example, in the case of the independent variable $\boldsymbol{h}^{(OE\text{sim})}$, we introduce an extra control variable $\boldsymbol{b}^{(OE\text{sim})}$ which corrects the log-odds estimation of $\boldsymbol{h}^{(OE\text{sim})}$ by introducing a baseline probability for those pairs k, l that share no online endorsees, and for which it is then impossible to compute a similarity value. We provide additional details and specifications of all our control variables in the supplementary materials.

RESULTS AND DISCUSSION

Comparing online endorsement and offline support: descriptive analysis

Our sample of 163 Swiss MPs results in 26,559 cosponsorship ties and 55 direct online endorsements. Table 1 shows summary statistics of online and offline support. If an MP endorses another MP online, they also tend to sign more of their bills (in absolute numbers, Welch two-sample t-test, average cosponsorship signatures for no online endorsement = 1.00, average cosponsorship signatures for online endorsement = 3.03, p-value = 0.004). Because the 163 MPs represent a subsample of both parliament members and Politnetz users, we calculate the online similarity of endorsees among MPs. For each pair of MP, we check whom they endorse online and calculate the share of endorsements the two MPs have in common. As such, online similarity represents a less biased closeness measure of online support among MPs. We find that cosponsorship support and online endorsement similarity are weakly associated (absolute values, Pearson correlation coefficient $r = 0.376$).[8]

TABLE 1 Summary table of offline support and online endorsement

Variable	n	min	max	mean	sd
Number of bills proposed per MP (48th)	101	0	126	31.2	23.9
Number of bills proposed per MP (49th)	143	0	118	32.2	23.5
Number of cosponsorship signatures given per MP (within sample)	163	0	536	162.9	118.4
Share of bills supported per MP (within sample)	163	0	0.18	0.09	0.03
Number of MPs endorsed online (within sample)	163	0	2	0.34	0.55
Number of cosponsorship signatures between MPs (within sample)	26406	0	75	1.0	3.2
Politnetz support (within sample)	26406	0	1	0.002	0.046
Politnetz similarity (within sample)	26406	0	1	0.1	0.18

[8]Note that higher correlation coefficients can be achieved if many MPs have both low endorsement similarity coupled with low cosponsorship support. This may lead to the wrong conclusion that an association between the two measures exists. To alleviate the bias, we turn to inferential methods of comparison in the next Section.

Both online endorsements and offline cosponsorship support are strongly guided by party homophily, i.e., support exchanged between members of the same party. We find that MPs cosponsor each other at higher rates if they belong to the same party (Welch two sample t-test, average cosponsorship signatures across party = 0.43, signatures within party = 4.00, p-value $< 2.2e-16$) and have more endorsees in common (Welch two sample t-test, average endorsement similarity across party = 0.05, average endorsement similarity within party = 0.38, p-value $< 2.2e-16$).

Figure 1 shows two heat plots to illustrate party homophily for online and offline support similarities. Parties are ranked from most right (EDU, SVP) to most left (SP, GPS) (after Bakker et al., 2014). Figure 1(a) shows average online similarities between parties. The highest values are obtained over the diagonal for online similarity, indicating strong partisanship in online endorsements. Figure 1(b) shows the average share of cosponsorship signatures between parties. Here, the diagonal is less prominent, indicating that within-party support plays less of a role in cosponsorship activities, especially for centre to right parties.

Since cosponsorship signatures are tied to the number of bills an MP proposed and the time they served in the National Council, analyzing offline support without controls is misleading. Furthermore, since observations are non-independent, p-values should be interpreted with caution. To alleviate these biases, we turn towards an inferential analysis that controls for the number of bills an MP proposed, the legislative periods, and whether or not two MPs served together.

Explaining offline support with online endorsements: inferential analysis

Table 2 reports the results of the gHypEG regression on cosponsorship support. We report four different models. Model (1) checks for the correlation between direct online and offline

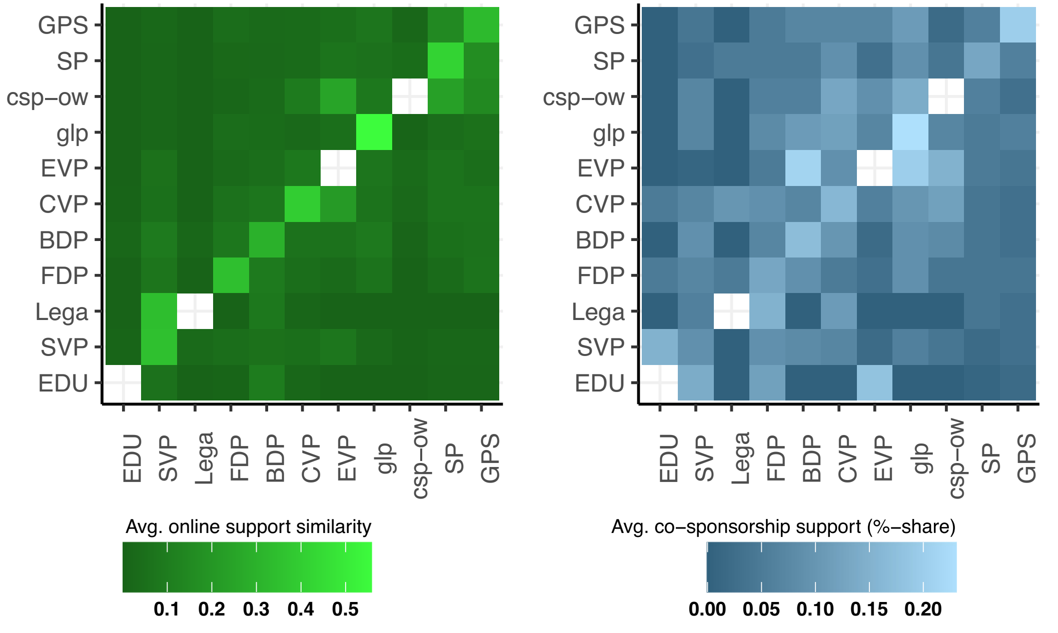

FIGURE 1 Heatplot for within and between party support. (a) represents average online endorsement similarity between MPs and (b) represents average share of cosponsorship support among MPs within and between different parties. Csp-ow, EVP, Lega and EDU only had one representative in parliament and no similarity score is calculated for themselves.

TABLE 2 gHypEG regression on cosponsorship signatures

	(1)	(2)	(3)	(4)
Online behavior				
Direct online endorsement	0.621 (0.078)***			
Online endorsement similarity		0.771 (0.007)***	0.041 (0.009)***	0.068 (0.009)***
Endogenous variables				
Reciprocity (weighted)			0.267 (0.008)***	0.378 (0.007)***
Shared partners (incoming, weighted)			0.097 (0.009)***	
Shared partners (outgoing, weighted)			0.038 (0.008)***	
Shared committees (weighted)			0.071 (0.027)**	
Homophily				
Gender homophily			−0.020 (0.013)	
Age difference			−0.096 (0.007)***	
Party homophily			1.154 (0.020)***	1.027 (0.020)***
State (=Canton) homophily			0.416 (0.020) ***	
Control				
Online endorsement activity		−0.041 (0.005)***	−0.030 (0.006)***	−0.015 (0.006)
Correcting factors (dummies)				
Online endorsement similarity (dummy, vs. no support)		−2.492 (0.020)***	−0.099 (0.027)	−0.201 (0.028)***
Online endorsement activity (dummy, vs. no activity)		0.007 (0.053)	−0.004 (0.053)	−0.005 (0.053)
Reciprocity (dummy, vs. no reciprocity)			−0.952 (0.020)***	−1.007 (0.020)***
Shared partners (incoming, dummy, vs. no partners)			−0.013 (0.018)	
Shared partners (outgoing, dummy, vs. no partners)			−0.171 (0.017)***	
Shared committees (dummy, vs. no committees)			−0.119 (0.014)***	
Age difference (dummy, vs. no difference)			0.036 (0.036)	
AIC (relative)	40523.916	20342.138	0.000	1295.242
McFadden $pseudo - R^2$	0.029	0.227	0.428	0.415

*** $p<0.001$; ** $p<0.01$; * $p<0.05$.

support. Model (2) checks for the correlation between offline support and online endorsement similarity. Model (3) reports the correlation between online and offline support under the control of different variables that have been shown to influence support among MPs. Model (4) reports the correlation between online and offline support while controlling only for partisanship and reciprocity.

In Model (1), results indicate that there is a positive correlation between online and offline political support. MPs who directly endorse each other online on *Politnetz* also cultivate a supportive relationship offline. The odds of MP i cosponsoring the bill of MP j increase by a factor of 1.9 ($e^{0.621} = 1.86$) if i endorses j online. Interestingly, online endorsement cannot account for the variance in cosponsorship activities (see near-zero pseudo-R^2 for Model (1)). This result indicates that even though there is a positive relationship between online and offline support,

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offline support presents itself as more complex than online endorsement. Since our sample consists of MPs active in parliament and on *Politnetz*, the results of direct online endorsement may be distorted.

To alleviate this bias, we operationalize online endorsement as endorsement similarity and test its correlation with offline support. By including the similarity measure of online endorsement, we see that the positive (and significant) effect holds. Even more importantly, around 22.7% of the variation of offline cosponsorship support is explained through online behavior. Increasing the similarity from 0 (no similarity among online endorsees between two MPs) to 0.5 (moderate similarity, 50% of endorsees in common), increases the odds of cosponsorship support from i to j by a factor of 7 ($0.5^{0.771}/e^{-2.492} = 7.08$). This seven-times increase in the odds, if online endorsement similarity increases from dissimilar to moderately similar, also coincides with some explanatory power over offline support. However, the explained variation is not as large as it could be, indicating that offline political support dynamics are richer and more complex than online political endorsement dynamics.

Our third model includes a range of control variables previously used to explain cosponsorship dynamics. Upon the inclusion of these additional explanatory variables, the online endorsement similarity effect reduces to near zero, indicating a strong correlation among online endorsement similarity and one (or multiple) control variables. The odds of MP i cosponsoring MP j if their online similarity increases from negligible to moderate only increase by a factor of 1.07 ($0.5^{0.041}/e^{-0.099} = 1.07$).

Figure 2 reports marginal effects of online endorsement similarity on cosponsorship tie probabilities. Figure 2(a) is based on Model (2) and depicts the positive effect of online endorsement on offline support. The support is non-linear, with a steeper increase as online similarity increases from 0% to 25% endorsement similarity. Figure 2(b) is based on Model (3) and shows how the online endorsement similarity effect reduces to a near-zero effect upon the inclusion of additional parameters. We tested which of the control variable masks the online endorsement similarity.

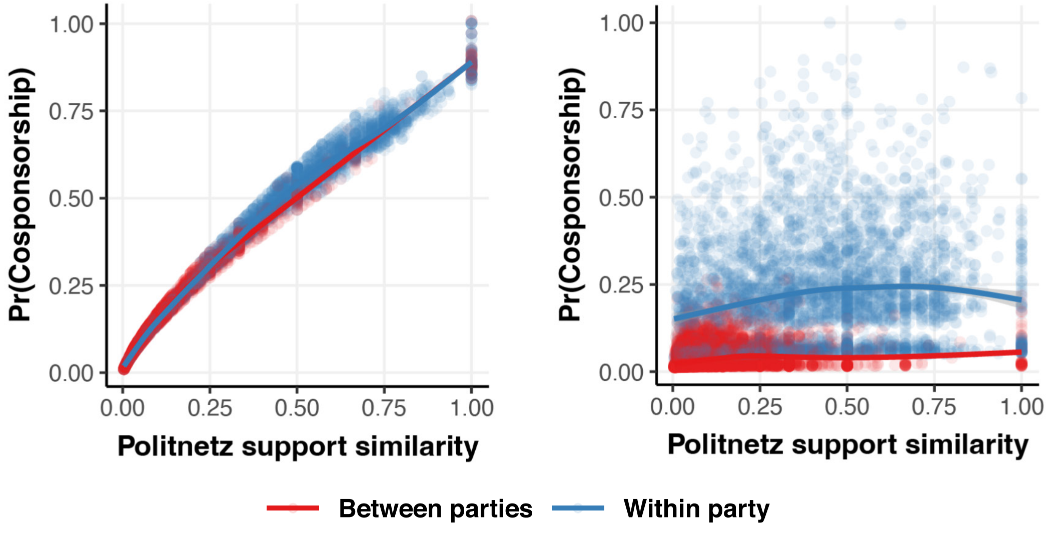

FIGURE 2 Marginal effects of endorsing each other online on the probability of cosponsoring each other's bills offline. (a) is based on model (2) in Table 2, (b) is based on Model (3) in Table 2. The effect of online endorsement similarity is reduced to near-zero upon the inclusion of control variables for offline cosponsorship. Party homophily mainly drives the positive effect of online similarity.

Model (4) shows that by controlling offline support with party homophily and reciprocity, the online endorsement effect diminishes to a near-zero effect. The estimates of Model (4) indicate the strong correlation between party homophily and online endorsement, indicating that online endorsement is mainly driven by party homophily. This result is surprising for two reasons: (i) Switzerland is a consensus democracy with a weak party structure. Previous studies indicate that adhering to party lines and party unity is less crucial in the Swiss political landscape (Bailer & Bütikofer, 2015; Schwarz, 2009). The fact that it presents as strongly in online political behavior is contradictory and warrants additional analyses. (ii) The substantial reduction in effect size for online endorsement by the inclusion of only party homophily shows that online endorsement dynamics are less varied and not as complex as offline support.

Online endorsements beyond party lines

Beyond party homophily, there are still a few MPs who support the same politicians *online*, but are part of two different parties. Granted, these cases are rare (and therefore difficult to detect statistically), yet they exist. One example poses council members Louis Schelbert and Yvonne Feri. Both were active members of parliament between 2011 and 2015. Louis Schelbert is part of the green party (GPS), and Yvonne Feri is part of the left party (SP), representing both left parties in the Swiss parliament. They represent different cantons (Luzern and Aargau, respectively) but served on the same committee between 2011 and 2015 (Control Committee), possibly explaining their online endorsement similarities. A second example poses Hansjoerg Hassler (right party, SVP) and Rosmarie Quadranti (right-to-middle party, BDP). They are part of the same parliamentary group (or fraction) since the parties share conservative leanings. During the time Rosmarie Quadranti served (2011–2015), Hansjoerg Hassler was president of the parliamentary group, possibly explaining their online endorsement similarities.

These two examples illustrate that some traces of parliamentary support are reflected in online endorsement behavior. We find three small drivers that facilitate inter-party similarities: cantonal homophily, gender and shared committee activities. First, both within and between party pairs show slightly higher online similarity if both MPs come from the same canton (significant t-test, see supplementary materials for details). Second, if we compare pairs of MPs with high online similarity, we find that cross-party endorsement similarities are higher for MPs with different gender (0.67) compared to both MPs identifying with the same gender (0.55). Another small driver of non-partisan support is sharing the same committee activity. Third, MPs with high online endorsement similarity have a higher average similarity if they shared a committee seat with the respective other MP (mean similarity of 0.66 for MPs who did not share committee membership versus mean similarity of 0.74 for MPs who have one or more committee assignments in common; t-test, $t = -2.1714$, $p - value = 0.033$) (see supplementary materials for details).

It has to be noted that all these effects are small in size and are only used here to examine potential other drivers of online endorsement similarity. Compared to party homophily, none of these other drivers comes close in size and power, indicating that Swiss MPs present strong party unity online. However, some traces of offline support are mirrored in online endorsement.

CONCLUSION

The external validity of data on online political behavior is not always given. We examined online and offline political support among MPs and found evidence that data on online political behavior is less varied than offline behavior. Notably, online political endorsement amongst MPs cannot fully explain cosponsorship support amongst MPs and is mainly driven by partisan support.

Our results question the extent to which online political behavior can be used as a proxy for offline or real-world political behavior. Do politicians present themselves differently online? Can analyses performed with online data on political behavior, for instance, to examine coalition formation or political ideology, be trusted to represent a politician's behavior in the real world? While some previous studies have found (spurious) correlations between online and offline behavior, our results are more sobering. If online endorsements on *Politnetz* were to be used as a proxy for political support, it may lead to the conclusion that alliances are much more party-driven and far less consensual (or issue-driven) than previously shown. It could further lead to conclusions of increased polarization in Swiss politics, simply because there is fewer mixing between party members online than previously found offline. Thus, interchanging data sources without prior tests for their external validity may lead to deceptive conclusions. In our case, online data does not equate offline data.

There are several limitations to the present study that call for additional research on the external validity of online data on political behavior. First, our analysis is cross-sectional, overlapping two data sets from around the same time, 2007–2015 for the parliamentary cosponsorship data and 2009–2016 for the online *Politnetz* data. Both data sets are temporal: cosponsorship signatures are submitted on specific dates and time-stamps of online endorsement instances are available. Nevertheless, it is impossible to causally link the two data sets, which is why we resorted to a cross-sectional analysis. Weaver et al. (2018: 133) address this issue in lamenting that inferring relations from online data is challenging and has its pitfalls as the system is so dynamic.[9]

Second, we had to restrict our analysis to MPs who were present in both data sets. Out of 321 MPs who served during the 48th and 49th legislative period, 163 MPs were active on *Politnetz*. We compared the offline, cosponsorship support among these 163 MPs with their online endorsement behavior. While we ensured that our network statistics accounts for dependencies and control-variables are calculated on the respective full networks (offline and online), we still have a likely bias due to missing observations. Additional studies with more complete comparison data sets would be valuable.

Third, while our study controls for online endorsement activity, we do not control for the time MPs spend on *Politnetz*. We look to future studies to expand on the different ways politicians engage with each other online (such as spurring debates or sharing each other's content), and how these activities relate to offline debates and support.

Fourth, we examine the online and offline behavior of Swiss MPs elected to the lower chamber, the National Council. Switzerland is a consensual-federal democracy with a multi-party system. It is known that Swiss politics is less party- and more issue-driven and that alliances are formed based on political positions on a given issue or regional closeness (Bailer & Bütikofer, 2015; Hertig, 1978; Lanfranchi & Lüthi, 1999; Schwarz, 2009). The strong partisan endorsements exhibited online by Swiss MPs *could be* interpreted as a show of party unity for the electorate, while political alliances offline (directed towards the political elite) are more consensus-oriented. We leave it to future studies to examine this link between the political (and party) system and online behavior of the political elite.

An important issue to consider when studying the external validity of online political data is the set-up of the platform itself and how it uses technical or algorithmic manipulations

[9]Promising longitudinal tools for future comparisons include relational event models (Butts, 2008) and higher-order networks (Lambiotte et al., 2019).

to guide their users in their behavior. The freely available data on engagements of MPs on the social media site *Facebook* or the microblogging platform *Twitter*, for instance, may not provide clear assessments of the external validity of online data. Many online social media platforms provide their users with 'recommendations' of users to follow or support or of posts to like and share. These 'recommendations' *possibly* bias the results as users do not freely choose other users to follow, support, or like, and are presented with specific opportunities to support some users at higher rates. As MPs are arguably aware of their colleagues, the following network may not be affected too much by such manipulations. The support behavior, however, can be distorted by the platform recommending posts to like or share based on the ideological (or social) closeness of other users online. While there is no solution (i.e., manipulations cannot be turned on or off), we urge future studies to beware of this possible limitation.

Studying online political behavior can have its merits, but linking it back to real-life outcomes gives it more depth. We look forward to additional research on the topic, linking online coalition formation or online endorsement to voting outcomes or new legislative proposals by groups of MPs formed online. We examined online and offline support among MPs in a multi-party, consensual-federal democracy. Our results show that online political endorsement is guided mainly by party lines. Future studies should be conducted in different political systems and studying different political behavior on- and offline.

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OPEN RESEARCH BADGES

This article has earned Open Data and Open Materials badges for making publicly available the digitally-shareable data necessary to reproduce the reported results. The data is available at https://doi.org/10.5281/zenodo.6372825

DATA AVAILABILITY STATEMENT

The data (and script) that support the findings of this paper are openly available in our ZENODO repository https://doi.org/10.5281/zenodo.6372825.

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