Leaders and participation in transnational internet governance

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Abstract

We examine cross-national variation in participation in transnational internet governance. Recent years have seen growing interest in the political relevance of arenas such as the Internet Engineering Task Force (IETF). Yet little is known about who participates in internet governance. The general literature on transnational governance suggests that participants come from the world's developed and free economies and, more generally, from countries with favorable domestic conditions. We offer an alternative explanation that links variation in participation to the distribution of transnational leadership positions across countries. By providing information patronage, leaders facilitate participation from actors in their networks. We offer evidence consistent with this view based on new data on transnational participation and leadership in the IETF, covering thousands of engineers from hundreds of countries and organizations around the world. Our results have implications for legitimacy and policy bias in transnational governance.

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Introduction

What explains cross-national variation in participation in transnational internet governance? Recent years have seen growing interest in internet governance arenas such as the Internet Corporation for Assigned Names and Numbers (ICANN) and the Internet Engineering Task Force (IETF). However, most literature so far focuses on the political relevance and daily operation of the engineering communities that run these arenas (Koppell 2005; Russell 2006; Mueller 2010; de Nardis 2014). Less attention has been paid to the question of who participates in internet governance in the first place. This is especially important since scholars suggest that key arenas work consensually, and all involved actors have a chance to shape outcomes. Yet, signs of overrepresentation of US actors and growing participation from emerging economies notwithstanding (Contreras 2014; Galloway and Baogang 2014; Carr 2015; Powers and Jablonski 2015), the literature does not offer expectations and evidence on internet governance participation.

Building on the general literature on transnational governance, we contribute new arguments, data, and evidence. First, whereas most literature argues that participation in transnational governance hinges on domestic conditions, we suggest that leaders at the transnational-level provide selective information to and thus facilitate participation by some actors rather than others. Second, while little systematic data currently exists, we provide new information on participation and leadership in a key arena, the IETF, covering thousands of engineers from hundreds of countries and organizations. Third, we offer evidence consistent not only with the view that the distribution of transnational leadership positions shapes participation, but also with the so far untested assumption that variation in participation relates to transnational policy output.

We share the standard expectation that participation is a privilege of actors from developed and free economies—and, generally, shaped by domestic conditions (Bexell, Tallberg, and Uhlin 2010:86–87; Andonova, Hale, and Roger 2017; Kahler 2017; Roger, Hale, and Andonova 2017). However, we advocate greater attention to transnational sources of participation. We stress a transnational factor: the distribution of formal leadership roles. Variation in the distribution of leadership positions is expected to explain participation in addition to domestic factors. We highlight the mechanism of information patronage. By providing selective information about transnational arenas, leaders facilitate participation by actors within their national networks.

Our argument relates to selected studies of the characteristics of transnational arenas and the path-dependence of participation. First, we agree that participation often proves path-dependent but do not explain this based on change-resistant domestic factors (Mattli and Büthe 2003; Fu, Pietrobelli, and Soete 2011). Rather, we emphasize that leaders reproduce, due to the selection mechanisms at work in the IETF, and therefore constitute a transnational source of path-dependent participation. Second, we acknowledge studies of participation-related features of transnational arenas, such as participatory mechanisms (Dingwerth 2008) or the exclusion of actors from elite networks that run these arenas (Carroll and Carson 2003; Stephen 2014). Yet, while these contributions do not actually establish a link to participation, we offer expectations and evidence about the relationship between leaders and participation in internet governance arenas.

We provide new data and evidence. Except for Andonova and colleagues' (2017) data on climate governance, no other global dataset on participation or the distribution of leadership in transnational arenas exists. We assembled a decade (2008-2017) of new data for a key arena, the IETF, enabling us to map and analyze participation and leadership on a large scale. We find highly uneven participation and a dominant role for US-based private actors. Participation from elsewhere, including China and other emerging economies, is limited and driven more by public and academic organizations. We also observe strong path-dependence in participation. Our multivariate analysis suggests that IETF participation from some countries has increased alongside domestic technological development. Nevertheless, cross-national participation differences persist and reflect lasting variation in the distribution of IETF leadership roles across countries.

Finally, the relevance of these findings depends on whether there is a link between who participates in the IETF and policy output. Research on transnational governance assumes that changing participation—e.g. greater inclusion of "Southern" actors (Dingwerth 2008)—would influence output. However, even the most systematic studies do not examine this participation-output relationship directly (Andonova et al. 2017; Roger et al. 2017). In contrast, based on original data on IETF standards and technical commentary, *Requests for Comments* (RFCs), we find a strong correlation between participation and output in the IETF and thus first evidence for a hitherto unexamined link in transnational governance.

Our findings have implications for legitimacy and policy bias in transnational governance. First, many transnational arenas, including ICANN and the IETF, have faced legitimacy challenges from emerging economies aggrieved by perceived underrepresentation (Dingwerth 2008; Kahler 2013). Our results suggest that participation differences partly stem from transnational factors and are likely to persist even if countries catch up economically. Second, many policy arenas have been said to display certain policy tendencies such as, in the case of the IETF, against government interference in technology governance (de Nardis 2015). The selection and patronage mechanism put forward here might help explain the persistence of such biases.

Transnational internet governance

We study transnational internet governance: decision-making about the operation of the internet—a global infrastructure. In a narrow sense, internet governance refers to the management of the internet's addressing and domain name system by ICANN, and standard setting in networks such as the IETF or World Wide Web Consortium. In a wider sense, Nye (2014) identifies over 50 engineering organizations, arenas and networks in the regime complex for the governance of internet-based activity. The IETF, which we analyze, thus exemplifies core internet governance.

Internet governance is an interesting context to study transnational participation. First, key arenas exemplify the complex multi-actor environment of contemporary transnational governance (Raymond and de Nardis 2015). The IETF emerged from US engineering research communities but has always also involved government agencies. In the 1990s, companies and civil society have also become increasingly relevant (Simcoe 2012; Naughton 2016). The IETF includes actors from

around the world (see below) and thus speaks to the view that transnational governance is relevant beyond, yet possibly still biased in favor of, the transatlantic domain (Dingwerth 2008).

Second, if we classify the authority of transnational arenas based on whether they share information, strengthen capacity, or make rules and decisions (Andonova, Betsill, and Bulkeley 2009), arenas such as ICANN and the IETF are closer to the authoritative end. They make important operational and standards decisions in addition to providing technical information. As we explain below, these activities have political implications. The authority of internet governance arenas justifies interest in who participates.

Third, transnational arenas vary in formal openness and opportunities of participants to shape decisions (Dingwerth 2008; Tallberg, Sommerer, Squatrito, and Jönsson 2013). This means that in some cases participation is either preordained by formal rules or of limited interest because participants lack opportunities to make a difference. Internet governance arenas vary in this respect (e.g., van Eeten and Mueller 2013). However, the IETF in particular has low formal participation and decision-making barriers. This makes it particularly important to understand actual participation.

Finally, even though internet governance, and the IETF are interesting cases to analyze participation, the available literature neither offers systematic arguments and evidence of the extent and nature of participation nor discusses whether general work on transnational governance might already explain participation outcomes sufficiently. We develop these points based on the two best-known internet governance arenas: ICANN, the most-studied arena, and the IETF, which we examine.

The political implications of internet governance

Key internet governance arenas do not only make technically demanding but also politically sensitive choices. Consider ICANN, a non-profit organization with a centralized structure and advisory bodies for stakeholders (E.g., Weinberg 2000; Koppell 2005; Take 2012). It has two competences: the management of domain names and internet addresses and the creation of top-level domains. While these functions are technical, studies show that they have a political side (de Nardis 2012:726–729; Bradshaw and DeNardis 2018). First, by disconnecting a domain name and IP address, ICANN can hide content. This could serve various goals—e.g. to block content that is harmful, subject to intellectual property claims, or politically unwanted. Second, by creating new domains, ICANN raises the visibility of certain topics. This has led to debates about the considerations that should inform domain decisions (Mueller 2010:201–204).

The IETF also exhibits overlap of technical missions and political issues (for an overview, see ten Oever and Moriarty 2018). The IETF produces “Internet Standards” and technical commentary (published as RFCs) for the transfer of information via the internet. The IETF meets three times per year around the world. Between 2008-2017, these gatherings attracted over 30,000 attendees (see our data below). There are no formal participation requirements and membership. However,

there is a leadership structure of working group chairs and Area Directors who decide to consider communication standards for formal adoption. The IETF is a technical and engineering organization but can be politically relevant—mainly in privacy and data security. Privacy and data security might be stronger or weaker depending on how information is transferred. As standardizing this transfer is the IETF's core competences, it influences identifying information that senders have to reveal (e.g., physical location), levels of encryption, or the inclusion of loopholes (e.g., for law enforcement). These questions shape whether governments or others can monitor individuals as well as censor or use content (de Nardis 2009:77–93, 2015; Rachovitsa 2016; Rogers and Eden 2017:809).

Decision-making in the IETF and ICANN

The literature also shows low barriers to participation and decision-making. Scholars highlight that these arenas are run by engineering communities that favor knowledge-based and consensual processes over hierarchies. For example, Nye (2014:12) argues that the IETF belongs to a class of "transnational epistemic communities of people and groups that share ideas and outlooks."

Studies of the IETF decision-making process support this view. First, there are no formal barriers to participation or agenda-setting. All IETF participants can propose standards or other RFCs as well as amendments to proposals by other engineers. Second, the agreed benchmark for a valid argument is technological soundness (Froomkin 2003; Russell 2014; ten Oever and Moriarty 2018). The IETF Guidelines for Conduct require "reasoned arguments" based on "data and facts", emphasize "technical competence, rough consensus, and individual participation", "best engineering judgment", and demand that "no one shall ever knowingly…make a standard technically inferior" (Moonesamy 2014 sections 2.2 and 2.3; ten Oever and Moriarty 2018). Proposals for new standards are assessed against technical benchmarks. They have to show multiple, interoperable implementations and respond in detail to all objections. Third, the decision rules of the IETF lend importance to individual participants as any new standard will have to achieve widespread support across the IETF participants, working groups, and leaders (working group chairs and Area Directors). Proposals cannot be adopted if there are strong counter-arguments or many opponents (Bradner 1996:section 1.1; Russell 2006:55; Resnick 2014). Practitioners call the joint requirements of technical soundness and widespread support "rough consensus and running code" (Clark 1992; Russell 2006).

ICANN is more hierarchical and thus has higher participation and decision-making barriers. For this reason, it has been considered a less representative example of internet governance than the IETF (van Eeten and Mueller 2013). Yet, given these limits, even ICANN emphasizes knowledge and consensus. It is designed to foster consensus through extensive consultation and advisory processes (Berkman Center for Internet & Society 2010; Post and Kehl 2015; Hofmann 2016). In recent years, in the context of the US government relinquishing its authority over ICANN, these processes have been strengthened (Becker 2019). As the IETF, ICANN eschews political debate and emphasizes its technical orientation. For example, at the heights of debates about ICANN independence, the Internet Society wrote to the US Congress to stress, amongst other concerns, its

commitment to an internet "free of government control", the technical mandate of ICANN, and that "legitimate public policy issues like net neutrality, censorship, and human rights are being addressed elsewhere, and are not part of this discussion" (Internet Society 2016).

Overall, this overview shows that internet governance arenas—the IETF in particular—have low formal participation barriers. Moreover, individual participants can have an impact because of the consensual and knowledge focus and relative openness of decision-making. Yet, despite this, we know little about who the actual participants are and how participation varies. Is participation as inclusive as decision-making? How significant is the overrepresentation of US-based actors? Does participation from countries with growing technology sectors increase over time? What other factors encourage or hinder participation? These questions have received little attention.

This is not to ignore some existing research. Nye (2014:13) notes a dominance of US actors "for path dependent and technical expertise reasons". Other studies show the prominence of US and European actors in the IETF and World Wide Web Consortium, but also significant Chinese participation (Mathiason 2009; Contreras 2014; Carr 2015). Yet, no study offers more systematic arguments and evidence. This holds true for the leading contributions. De Nardis (2014) and Mueller (2010), for example, applaud the openness of internet governance but do not study who benefits from participation opportunities. While aware of potential participation imbalances, these studies do not offer systematic analyses of participation either.

Explaining participation in internet governance

We embed our discussion in the literature on transnational governance (Roger and Dauvergne 2016). We highlight economic and institutional explanations of cross-national variation in internet governance participation. However, we argue that these standard explanations do not suffice. We suggest paying greater attention to transnational sources of path-dependent participation. Specifically, we highlight that transnational leaders create persistent participation advantages for actors in their networks.

Economic and institutional explanations

The main explanation of participation in transnational governance emphasizes economic resources (Andonova et al. 2017:256). Participation in transnational governance arenas favors actors that can muster the resources required. These actors are most likely found in rich countries with resourceful private sectors. Moreover, private actors with the motivation to participate in transnational rulemaking are more likely in outward-oriented rather than inward-looking and sheltered countries and sectors. These favorable conditions are often lacking. Clapp (1998), for example, argues that actors in weaker economies lack the capacity to participate in environmental standard-setting. A resource-based or economic perspective suggests that factors such as the size and export-orientation of the economy, especially the technology sector, explain IETF participation.

Recent studies also suggest that the economy affects the composition of transnational participation. Participants from less advanced countries are said to come from research institutions and public agencies more often than the private sector. In technology governance, the reason is that involvement in transnational arenas from countries in which technology sectors developed later often depends on government policies. Many governments promote standard-setting and transnational standards leadership as part of their development goals (Fu and Gong 2011; Gao, Yu, and Lyytinen 2014; Xia 2017). Their efforts entail public agencies, state-sponsored research institutes and universities, and the orchestration of private governance. This means that the resources, competences, and incentives to participate in arenas such as the IETF are likely to be found in the public and academic sector to a greater extent than in more advanced economies. Thus, participation from these sectors might be more prominent. Outside of technology governance, governmental policies also play a larger role for transnational participation from less wealthy countries (Hale and Roger 2014; Andonova et al. 2017; Kahler 2017:162).

In addition to economic and technological development, we expect that domestic economic and political institutions influence participation in transnational internet governance (Roger et al. 2017:15–17). Transnational governance participation requires private initiative from domestic actors. Such initiative depends on political and economic freedoms. Stephen (2014), for example, suggests that illiberal state-society relations create state-dependent domestic actors that are ill-equipped for transnational arenas (see also Nölke, ten Brink, Claar, and May 2015). Without economic freedoms, domestic actors might not develop the capacities to participate as they are used to state-sponsored and domestic standardization efforts. In the absence of political freedoms, domestic actors might avoid internet governance given the fact that decisions can have political implications disliked by the government. For example, Galloway and Baogang (2014:92) argue that Chinese non-state actors favor government leadership in internet governance more than their counterparts in democratic countries. In light of these arguments, we expect greater IETF participation from actors in politically and economically free countries.

While we agree with these explanations, we see two issues. First, they focus on domestic conditions whereas participation depends on transnational factors as well. By exception, Dingwerth (2008) documents participatory mechanisms across transnational arenas. Stephen (2014) notes the exclusion of many actors from transnational elite networks. Yet, neither makes the link to actual participation. Second, existing explanations might underestimate path-dependence in participation. Especially resource-based perspectives suggest change if countries catch up in development. Again, there are exceptions, but these focus on the domestic level as well, stressing change-resistant institutions of sectoral interest aggregation (Mattli and Büthe 2003) and company and country-level innovation resources and incentives (Fu et al. 2011).

Transnational leaders, information patronage and participation

Our argument focuses on transnational leaders, thus highlighting a transnational rather than domestic source of path-dependent participation. We first argue that transnational leaders facilitate participation from some jurisdictions rather than others. The second part of the argument is that

transnational leaders reproduce, given the leadership selection mechanisms in the IETF, and therefore are a source of persistent participation differences.

We understand transnational leaders as actors in positions of authority in transnational arenas. By virtue of their roles, leaders have greater authority, visibility, and operational knowledge of transnational arenas than other actors. These attributes allow them to influence the composition of transnational arenas. First, their visibility serves to make unfamiliar individuals aware of and interested in the possibility to participate. Second, their authority and procedural knowledge allows leaders to explain how to participate impactfully, making participation more attractive. These mechanisms are salient in transnational environments, which are comparatively opaque and hard to access for outsiders, except with the support of insiders such as transnational leaders.

We expect that leaders employ their resources selectively. They supply information to actors within, and thus facilitate participation in transnational arenas from, their national and organizational networks. There are passive and active reasons for this. First, transnational leaders will be more visible and accessible to actors in close proximity, such as in their domestic economic environment. Second, leaders have an interest in supporting engagement of actors with similar technological, economic and political views. In order to find these likeminded actors, leaders are likely to focus on individuals in their networks about whom they have most information. Because our mechanism stresses this selective information transfer, we refer to it as information patronage.

Regarding cross-national variation, this argument suggests that participation will be greater the more transnational leaders are based in a country. As Stephen (2014) we assume that many actors will be excluded from the networks and leaderships that run transnational arena, but specify the implications for participation in these arenas. Since leaders are part of domestic economic networks, the information that they supply disproportionately benefits actors from the countries where they are based.

Accounts of IETF practitioners lend plausibility to this mechanism. For example, the following statement by a senior participant and early member of the Internet Architecture Board illustrates the network benefits that we envisage (St.Johns 2006):

> In 1986 my boss was Mike Corrigan, who was the first chair of the IETF…I was responsible for managing the development of the packet switches, the gateways and the terminal servers for the Defense Data Network. So, I saw this note about Gateway Algorithms and Data Structures meeting in San Diego and decided to go…With Mike Corrigan as the chair of the IETF, I ended up being one of the program chairs for the first one or two meetings together with Phill Gross until Mike departed and Phill took over as IETF chair.[1]

One might object that leaders perhaps influence participation, but this alone does not give rise to persistent or path-dependent participation patterns over time. If the leadership of a transnational arena adjusts quickly to changing circumstances, it would not be a source of path-dependence. Yet,

[1] We replaced abbreviations with full names. For other examples, see Contreras (2008), Marsan (2017).

if transnational leaderships reproduce—the informal elite networks Stephen (2014) highlights might be an example—the advantages that they confer will continuously benefit the same networks of potential transnational participants. The issue thus is the stability of the leadership composition.

Leadership stability depends on leader selection mechanisms. In the IETF, these mechanisms render leadership stability likely. The IETF procedures for selecting higher-level positions give existing leaders large discretion to determine which candidates serve "the best interests of the IETF community" (Kucherawy 2015:sections 3.7.3 and 4). Since the IETF is an engineering community, "best interests" will involve expertise as a factor, which creates room for change. Additionally, the minimum term of office for key roles is two years, which also facilitates turnover. Nevertheless, slow change is likely. First, new leaders are recruited from active participants. These are not a random group but resemble existing leaders due to the patronage mechanism discussed above. Second, existing leaders are likely to know and share the technological and political views of members of their networks. They are likely to favor these individuals over others for key roles.

In sum, this argument suggests greater IETF participation from countries where many IETF leaders are based. We also expect leadership stability over time and, therefore, path-dependence in participation.

Mapping IETF participation

We begin the analysis by mapping IETF participation. Since the theoretical discussion emphasizes variation across countries and over time, we focus on these dimensions. We also consider the composition of participants from different countries (e.g. more companies or public actors) since this relates to an expectation of resource-based explanations. Finally, we show the distribution of IETF leadership positions, which, we argue, might help explain cross-national participation differences. Our main observations are that participation and leadership varies strongly across countries, that this variation has persisted over time, and that this lends plausibility to our claim.

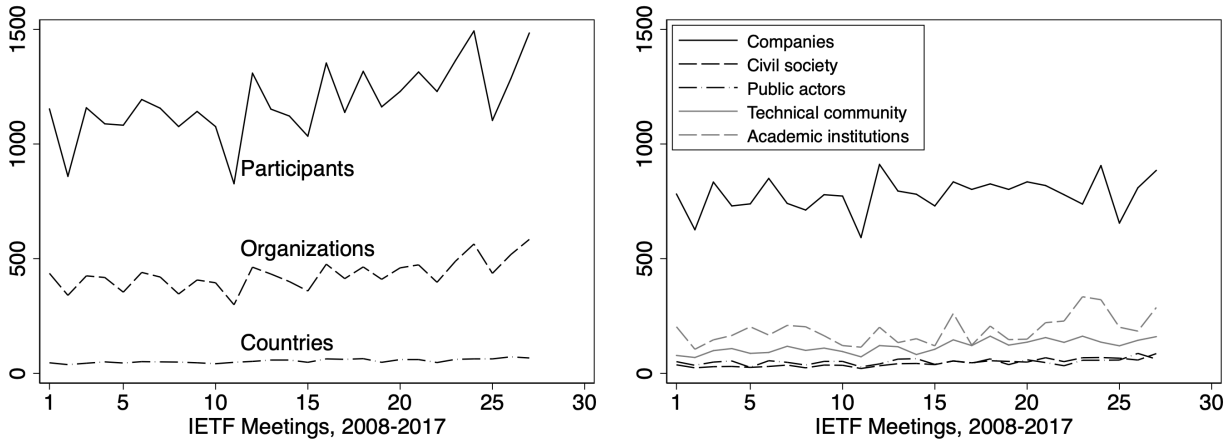
We rely on new IETF participation data. We coded participation in 27 meetings from 2008-2017. The IETF publishes attendance lists and organizational affiliations. We standardized the organization names and added countries based on headquarters.[2] We also classified the organizations as academic, civil society, companies, public (e.g. communication ministries), and technical organizations (e.g. major internet exchange points). In total, we obtained information on 31,899 participants from 144 countries and 2,799 organizations.[3]

[2] Where participants indicated an affiliation to a subsidiary (e.g. Google Japan), we recorded this but rely on the parent company's headquarter location in our analysis. We excluded countries below 1 million inhabitants for which little data is available.

[3] In total, the IETF recorded 38,009 participants. We found information for 84 percent (31,899). The other participants had not reported any organizational affiliation or, in few cases, had reported an affiliation but we were unable to find the organization and determine its location and type. There is no way of knowing what explains the missing information. However, even if we distribute them evenly, e.g., over the 144 countries and 27 meetings in the data, they would add only 1.6 participants per country and meeting. Even if we distributed them disproportionately to, e.g., poorer or autocratic countries, the changes would be too small to matter for the results and conclusions.

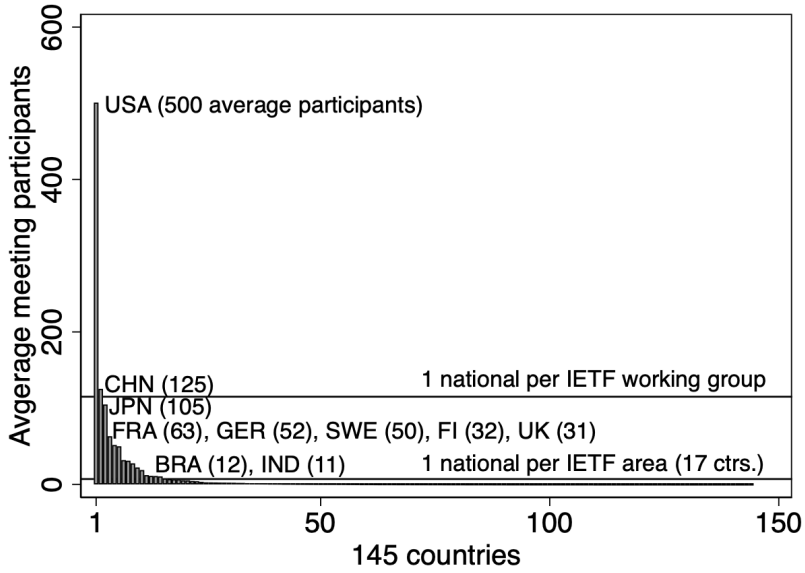
Figure 1. Trends in participation

a) Individuals, organizations, and countries **b) Participants by affiliation**



Note: For a list of all IETF meetings and raw individual, organizational, and country attendance levels, see Table A1 in the appendix.

Figure 2. Cross-national variation in IETF participation



Note: The horizontal lines are at 7 and 115 because the IETF currently operates 115 working groups nested in 7 areas. Only countries with at least as many participants can conceivably have at least one national in each group or area.

In general, we find that the IETF is a large and diverse arena of, mainly, private sector engineers. Figure 1, panel a), shows that over 1,000 individuals have attended meetings every 3-4 months since 2008. Participation has grown, but slowly. Most over-time variation reflects seasons and location. November meetings depress participation by about 140 compared to March and July. The busiest meetings were in Berlin and Prague, both in July, the least attended one in Taipei in November. On average, participants at a meeting come from 430 distinct organizations and 54 countries. As panel b) shows, participants from companies outnumber other groups. Academics and the technical community constitute a significant share of attendees, yet far from their role in the early internet (Naughton 2016). Public and civil society actors constitute only a small share.

Our focus is cross-national variation in participation. Figure 2 reveals an outsized US presence. The American attendance at an average IETF meeting is larger than of the next seven countries combined, including China, Japan and major European economies. As Contreras (2014), we also observe a large Chinese presence. Emerging economies such as Brazil and India lack behind. While they are not excluded (Stephen 2014), they have fewer participants than leading economies. To contextualize these numbers, consider that the IETF operates 115 working groups within 7 areas. Only the US could have several participants per group and only China at least one. Only 17 countries, on average, have as many participants as areas. While this comparison should not be taken literally since individuals can participate in several groups, it shows that the variation is large.

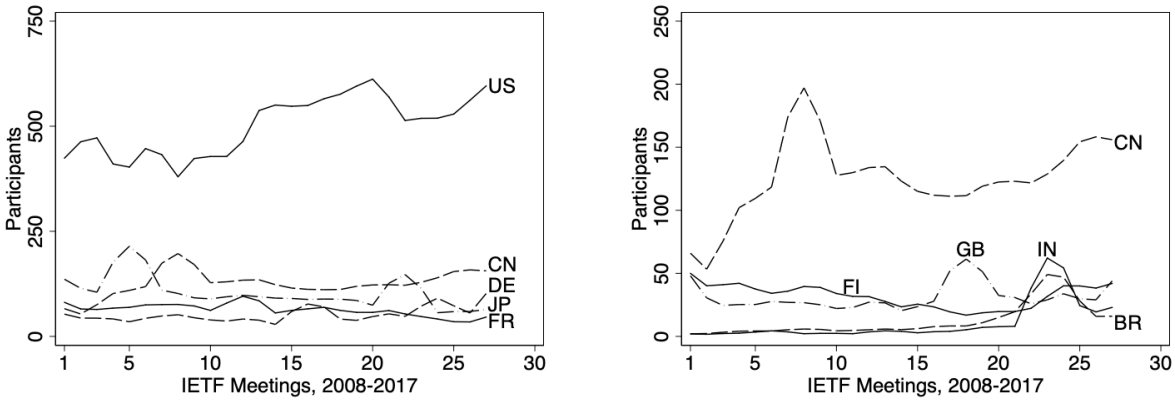
Figure 2 averages over IETF meetings, but cross-national differences might have changed. Resource-based explanations suggest change due to technological development. For example, Contreras (2014:929) expects that "Chinese firms … are poised to assume a position of leadership alongside long-term IETF participants from the United States, Europe and Japan." Yet, Figure 3 suggests little evidence of catching up for any major economy. There are short-lived hikes, but these reflect whether a country hosted an IETF meeting.[4] Chinese participation indeed grew until the late 2000s—we capture the end of this trend—but has been stable for most of the past decade. The participation leadership of US-based actors has grown rather than declined.

Figure 3 only captures nine countries. However, the impression of stability in participation levels holds across all countries and categories of actors. To test this, we regressed the participation level of a country in a given meeting on its level of participation in July 2008, the first meeting in our data. Attendance at this first meeting explains about 90 percent of variation in attendance at the subsequent 26 meetings. For some categories of actors for which participation is lower overall, the relationship is weaker but still strong with 70 percent of variation or more explained by attendance at the first meeting. Only academic presence in the IETF varies more. Overall, cross-national variation in IETF participation is highly stable.

[4] These hikes disappear immediately in the next meeting but appear to last here since we smoothed the trends.

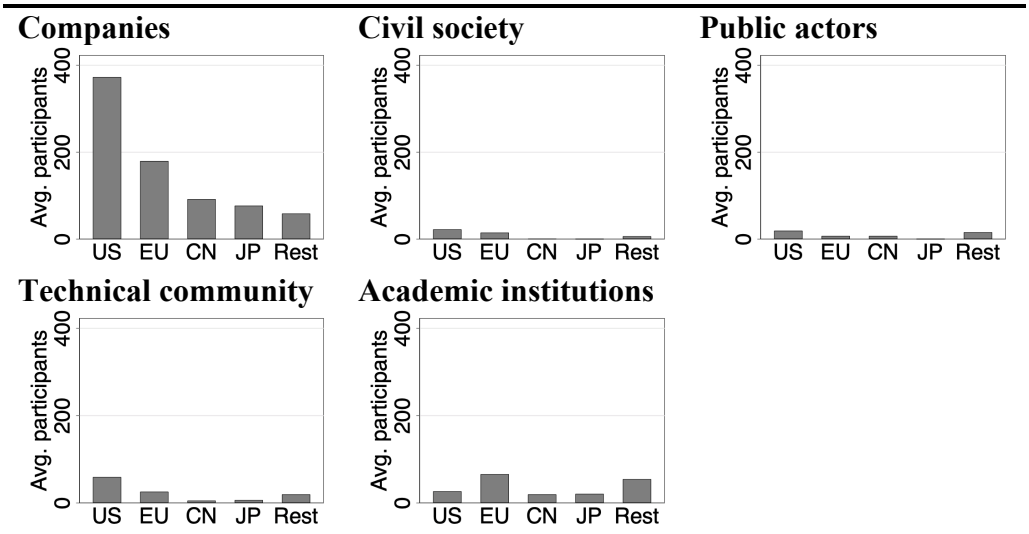
Figure 3. Trends in participation, selected countries

a) Participation: Selected countries I **b) Participation: Selected countries II**



Note: Note the truncated y-scale in panel b). China is shown in both panels for comparison. For ease of presentation, the lines were smoothed around windows of five observations.

Figure 4. IETF participants across affiliations and countries

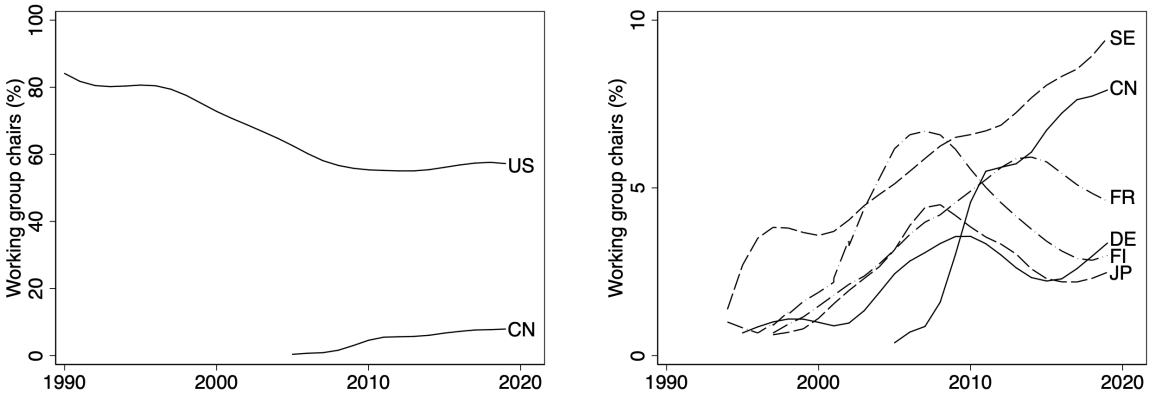


Note: The raw numbers underlying this figure can be found in Table A2 in the appendix.

Finally, we examine the composition of participants across countries. Some studies suggest that participants from poorer countries will come from public agencies and research institutions. Figure 4 shows that US-based participants are mainly from the private sector. As the host of the IETF, ICANN and other technical operations, many technical community affiliates are also US-based. Otherwise, there is more balance. There are as many civil society and more academic participants from European Union countries. Chinese participation relies (relatively) strongly on academics and the public sector, in line with claims that the government shapes China's approach to technology standards (Contreras 2014:918). Other countries are weakly represented but, as China, comparatively a lot by public and academic institutions. Reflecting the decentralized structure of the internet, the technical community is found across the world in, for example, address and domain name registries such as the Registry for Latin America and Caribbean or the African Network Information Centre.

Figure 5. Working group chairs by country, 1990-2019

a) Chairs from the USA and China **b) Chairs from selected countries**



Note: The figure shows working group chairs based on the country location of their organizations as a share of all chairs in office in a year. Note the different y-scale in panel b). China is shown in both panels for comparison.

We argued that variation in IETF leadership positions might help explain participation. In the IETF, working group chairs and Area Directors guide discussions during the RFCs adoption process. To assess the plausibility of our main claim, we examine new data on the distribution of Area Directorships in 2019 and on working group chairs since 1990. For our claim to be plausible, we would expect strong and persistent cross-national variation in the occupation of leadership positions. We indeed find this to be the case. First, ten of 15 current Area Directors are from US organizations (the other from British, Chinese, Canadian, Finish, and Swiss ones) and mostly from companies. Second, of the 242 working group chairs in 2019, 60 percent come from US organizations, followed by China and mostly European economies. In total, chairs come from only 18 different countries (see Figure A1 in the appendix). Second, variation over time is relatively limited as well. While US leadership in working group chairs declined as the IETF diversified

around 2000, it has since stabilized (Figure 5). While several countries have seen more working group chairs over time, these increases have been small in absolute terms.

This mapping exercise lends first support to all theoretical perspectives. In general, there is large cross-national variation in need of an explanation, as in other domains (Roger et al. 2017). In line with resource-based explanations, it appears that most participants come from the most advanced economies. Additionally, participation from less advanced economies depends relatively more on academic and public actors. Institutional explanations can highlight the apparent prominence of participants of economically and politically free countries, although China is a major exception. Since institutions change slowly, the persistence of participation is also compatible with institutional explanations. Finally, we claim three signs in support of a possible relationship between participation and transnational leadership: namely that both participation and leadership vary across countries, favor similar countries, and do so relatively consistently over time.

Operationalization of explanatory variables

To test these first findings further, we operationalize key variables associated to our arguments about economic and technological resources, political and economic institutions, and IETF leadership positions. The appendix includes summary statistics (Table A3).

For resource-based explanations, the obvious starting point is *GDP per capita*, which we take from World Bank data. Yet, GDP is unlikely to be as useful theoretically and practically as it correlates highly with other interesting variables. Hence, we mainly rely on more specific information about the size and outward orientation of the technology sector. For this, we rely on World Bank data on *ICT service exports*.[5] ICT service exports are appropriate as they indicate where the globally-oriented companies are that could have an interest in internet governance. We measure the absolute US-dollar (USD) value of service exports.[6] To account for the skewed distributions of GDP per capita and ICT exports, we log-transformed both. Finally, we measure the (logged) *distance* of each country's capital to IETF meetings and whether a country was the *host* of a meeting.

Institutional arguments emphasize *political and economic freedoms*. We rely on the polity index that places countries on a -10 to 10 scale from autocracy to democracy (Marshall, Jaggers, and Gurr 2011). We measure market freedom based on the Economic Freedom of the World (EFW) Index of the Fraser Institute.[7] On a 0-10 scale, the EFW index captures the extent to which private actors operate in the market uninhibited by governmental interference. It incorporates information on government size, legal certainty, and trade, monetary and regulatory policy. The EFW index is appropriate as it indicates whether private actors can act independent of the government.

[5] We do not use data on ICT goods exports since this could conflate technological capacity with dependencies in production chains. Countries might produce ICT goods for processing in richer economies.
[6] We do not take the share of GDP because this lets the technology sectors of large economies—e.g. China, the US, or Germany—appear misleadingly small.
[7] Available at: https://www.fraserinstitute.org/studies/economic-freedom (accessed 18 November 2018).

We stressed the importance of *IETF leadership*. We measure IETF leadership based on our data on working group chairs. Working group chairs are the least senior leadership positions in the IETF, yet closest to regular participants and sufficiently numerous to contain meaningful cross-national variation. We measure the distribution of chairs across countries (based on the country location of the chair's organizational affiliation). We expect that information patronage works with delay as information takes time to spread. Hence, we lag this variable by three years. Changing the lag makes little difference for the results, however. A concern is that leadership correlates strongly with US-origin because US actors are far ahead in the leadership distribution (see Figure 5). For the statistical analysis, we therefore categorized the variable into *no* working group chairs, *few* chairs (1-4), and *many* (5 or more).[8] This is substantively better since it acknowledges the leadership involvement from some other countries (e.g. China or Sweden) and technically preferable because these categories and US origin correlate weakly. The cutoffs are ultimately arbitrary but do not determine the results. With some temporal variation, the top group encompasses Canada, China, Finland, France, Germany, Israel, Japan, Sweden, the United Kingdom, and the USA. 16 countries have, at various points, had a few chairs.

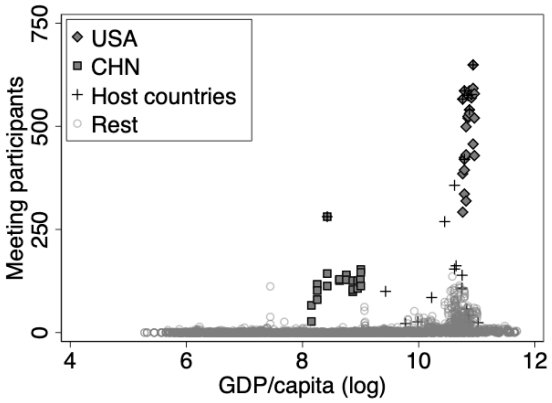
Bivariate and multivariate relationships

We first examine bivariate relationships in Figure 6. This supports resource-based and institutional explanations. IETF participation seems mainly a privilege of actors from wealthy and free countries. Except for China, democratic freedoms are close to a necessary condition for IETF participation and more clearly important than economic freedoms. The only factor that, to some extent, accounts for the substantial Chinese IETF presence as well as US dominance is the outward orientation of the ICT sector. Second, most participants come from countries where also many IETF leaders are based. Moreover, leadership is the variable that plausible distinguishes the US from other countries.

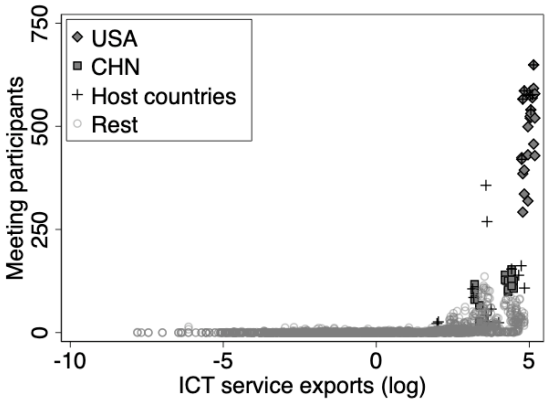
[8] Note that a log-transformation does not solve this problem as the distribution is too skewed.

Figure 6. Exploring the correlates of IETF participation

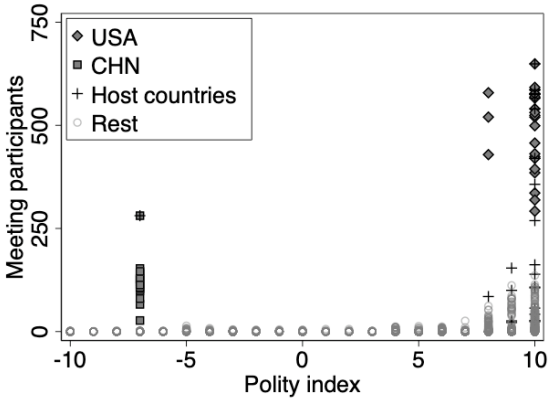
a) GDP per capita



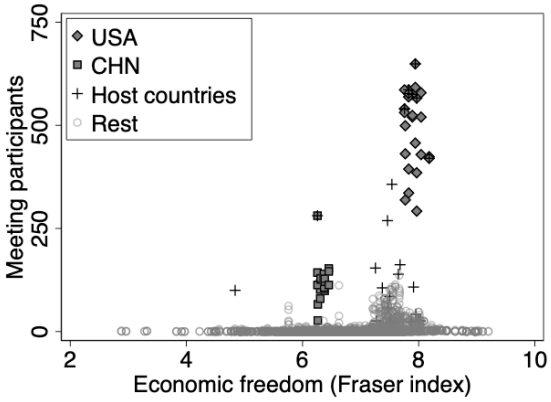
b) ICT service exports



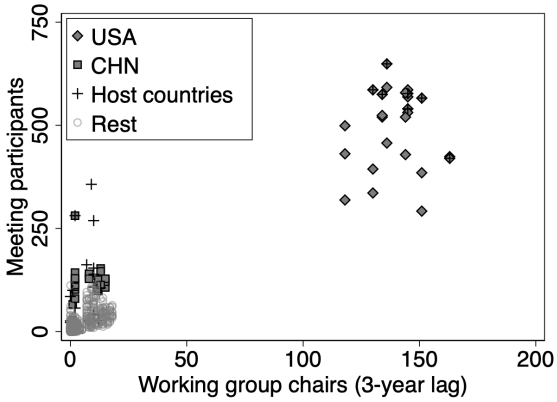
c) Democratic freedoms



d) Economic freedoms



e) IETF leadership



f) IETF leadership without USA

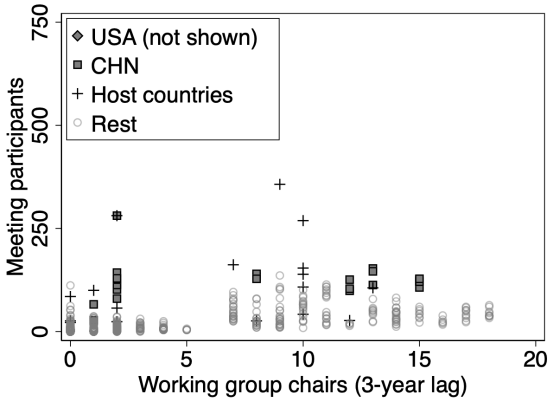
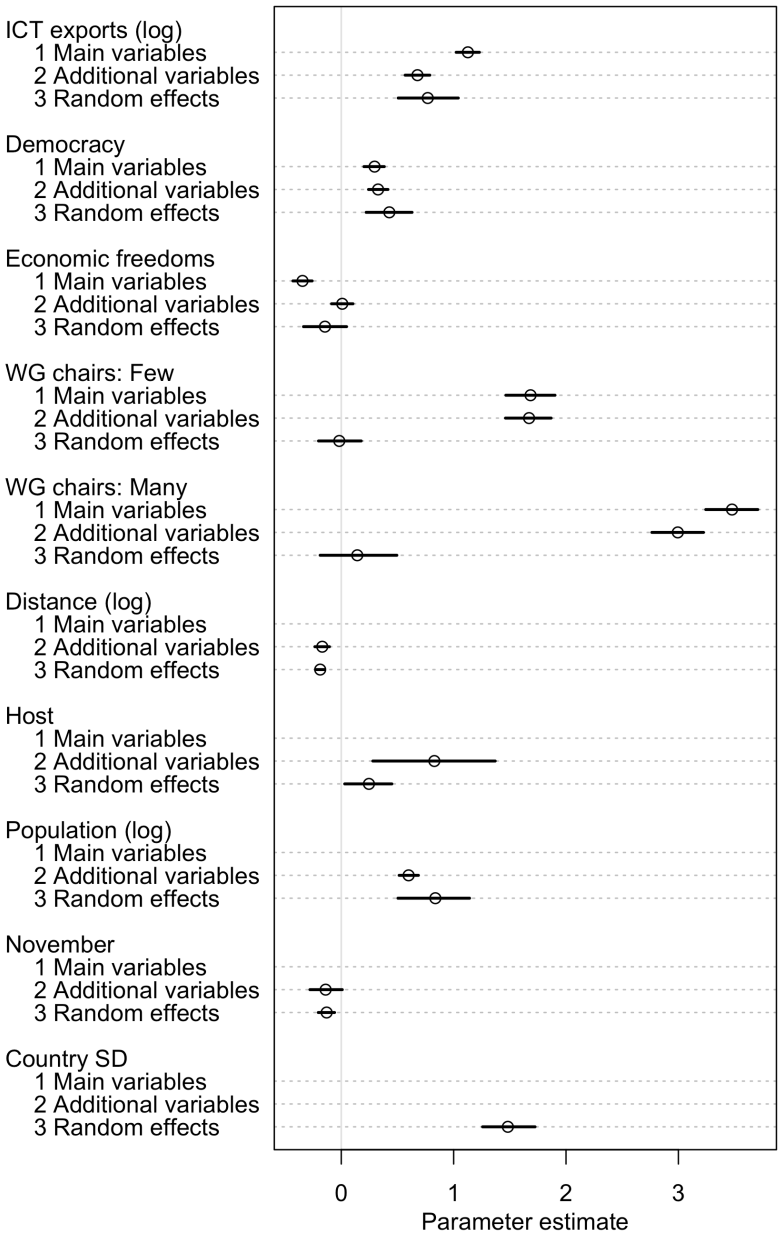


Figure 7. Statistical results



Note: The models rely on 2,627 observations from 124 countries and 25 IETF meetings. The bars show 95%-Highest Posterior Density Intervals.

To probe these patterns further, we present results of three multivariate models in Figure 7. Since our dependent variable is a count of the participants in IETF meetings, these are count models and involve additional steps to account for overdispersion and zeros in the data (the appendix includes a technical discussion). As noted, GDP per capita correlates with most variables of interest (ICT exports, democracy, economic freedoms, and leadership) and is therefore not included. Instead, we

start with a basic model with the key variables. The second model adds the distance to IETF meetings, population size, the host, and the November meeting. The third model adds random effects at the country level. Participation varies mainly between countries. Observations are therefore interdependent within countries. The country-level random effect will absorb most of this interdependence and indicate which variables might explain longitudinal variation. It is not advisable to include a year random effect, time trend, or lagged dependent variable, which would correlate strongly with the country random effects.[9]

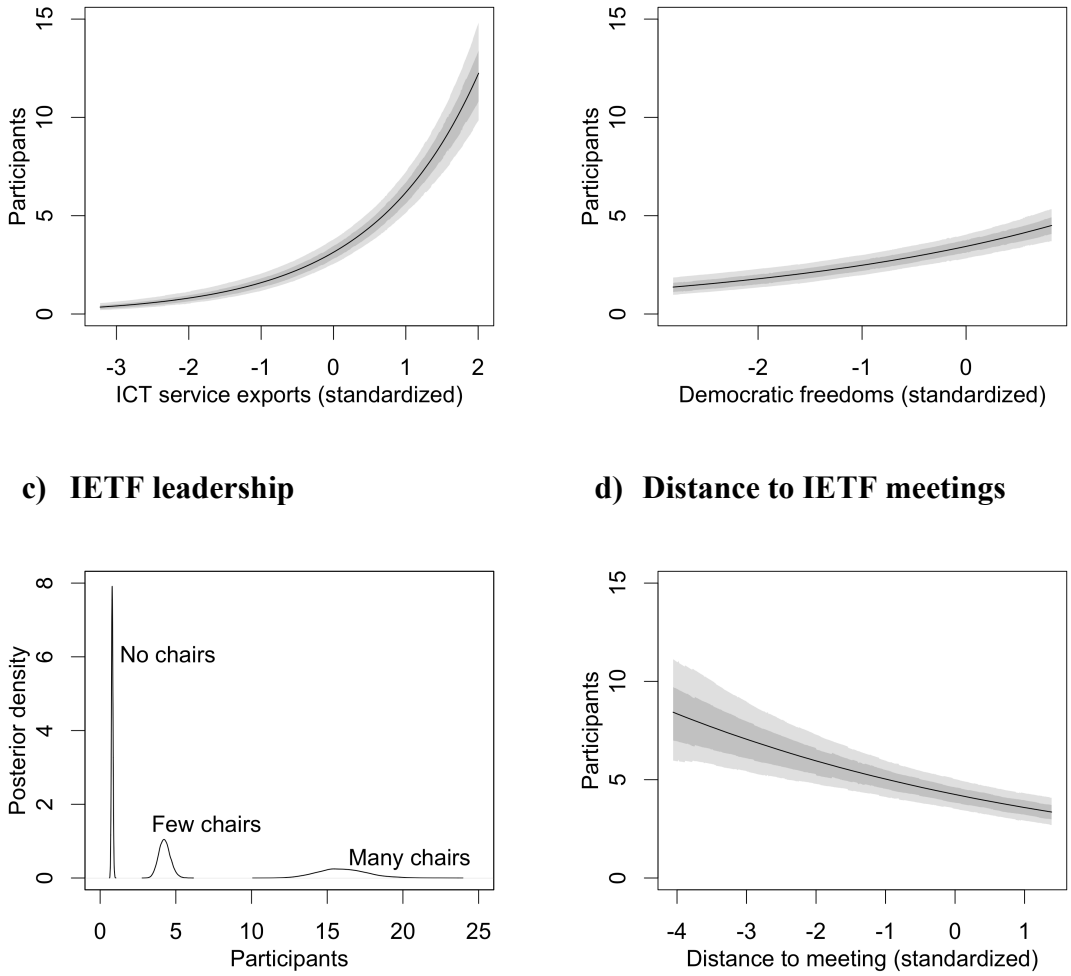
The results are in line with the discussion so far. Since all variables were standardized, Figure 7 conveys an impression of their relative importance. The most important factors are ICT exports and IETF leadership. Large and export-oriented technology sectors go together with participation. If at least a few or even many IETF working group chairs come from a country (the baseline being no chairs), participation is also higher. We observe weaker, positive relationships between democracy, proximity to the meeting, host status, and spring and summer rather than November meetings. However, the link between economic freedom and participation is ambiguous. In the model with country random effects, most results are similar. Yet, the leadership variables are not consistently positive and most relationships weaker. This is plausible since the distribution of IETF leadership positions has remained rather stable over time.

What do the results mean for actual participation? First, our models predict a low baseline participation level of 0-1 participants for countries that are not the host, have no leadership positions, and are at the mean of the other variables. For these countries, changes in individual variables do not make a big difference either. However, what about countries that are prone to participation in principle? Based on model 2, Figure 8 shows predicted participation during spring and summer meetings, for countries that are in the top third (66^{th} percentile) of ICT exporters, democratic quality, economic freedom, meeting proximity, and population size, and that have a few working group chairs.[10] In this group, changes from the observed minimum to maximum of the explanatory variables are associated with differences of around 10 (ICT exports) and 4-5 (democracy, a few rather than no working group chairs, and distance) participants. The countries with many IETF leaders, tend to have 15-20 additional participants per meeting.

[9] This is intuitive. With little within-country variation, either a country identifier or a lagged dependent variable will have quite similar practical meaning and, hence, correlate strongly and predict the outcome more or less equally well. It is neither advisable to include a year random effect or time trend as there is little evidence of a time trend or strong differences between years (beyond the November, host, and distance effects that we measure).

[10] This means that they export about 3.7 billion US-Dollars of ICT services, are at values 9 of the polity and 7.3 of the economic freedom indices, 6,200 kilometers away from the meeting, and have populations of about 25 million.

Figure 8. Predicted numbers of IETF participants

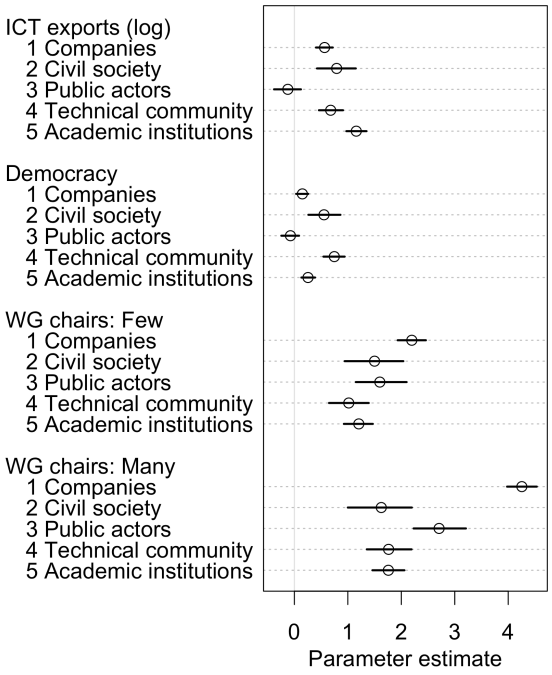


Note: The continuous explanatory variables were standardized with mean 0 and unit changes as standard deviations. The means and standard deviations of the unstandardized variables can be found in the appendix (Table A3). The predicted participation numbers are based on 14,000 draws from the posterior distributions of Model 2 in Figure 7. Panel c) shows distributions of probabilities for the three leadership categories that we distinguish. The shaded areas are 70 and 95%-Highest Posterior Density Intervals.

The results so far are in line with important resource-based and institutional expectation as well as an important role of transnational leadership. However, critical questions could be raised. For example, the results might depend on the categories of actors under consideration. We examined this issue by repeating our analysis with participation from different categories of participants as the dependent variable (Figure 9). The results need to be treated with caution since there are few participants in some categories. Nevertheless, the same factors that shape overall participation mostly apply. There are differences, however. First, public and to some extent academic participation depends less on the factors considered. This is consistent with the argument that countries with otherwise few participants can count relatively more on these groups. Academic

participation, moreover, is driven the most by ICT exports, perhaps reflecting research priorities in technology-oriented countries. Company and technical community participation is most affected by IETF leadership. A possible reason is that these groups have most contacts with IETF leaders who are also predominantly from the private sector and technical community. Moreover, these two groups are most directly involved in writing IETF output. For them, successful participation might depend the most on information provided by leaders. In turn, leaders might deem these participants most interesting as contributors and make most effort to bring them into the IETF.

Figure 9. Different categories of participants



Note: The models rely on 2,627 observations from 124 countries and 25 IETF meetings. The bars show 95%-Highest Posterior Density Intervals. For reasons of space, only selected variables are shown, but the same variables as in Figure 7 were included.

Further questions come to mind. Do the results depend on US observations? Are they driven by the inclusion in the analysis of many poorer countries with few IETF participants? And more technical concerns such as regarding the countries covered in the analysis. For instance, our analysis includes countries that have had at least one participant in the 27 meetings in our data—yet, perhaps countries that never had any participants should be included. We address these questions in the appendix and find that the results remain effectively unchanged.

Overall, the analysis shows that IETF participants come from technologically advanced, export-oriented, democratic countries with a significant IETF leadership presence. With some variation, this holds for all except public actors. The bivariate relationships suggest that these factors are

nearly necessary for participation, except from China. Actors from countries that do not meet them almost never attend IETF meetings. The picture for economic freedoms is more ambiguous although participation from economically unfree countries is virtually absent as well. The observed patterns are consistent with key claims of resource-based and institutional explanations of transnational governance participation, but also suggest that leadership, which we have highlighted, plays a key role. We acknowledge that our analysis does not allow strong causal claims but point out that the results are consistent with theoretical expectations. Moreover, even if we regard the results as nothing but descriptive, the point nevertheless holds that IETF participation is selective in identifiable and important ways—and that some of these ways, including the correlation between leaders and participants, had not been sufficiently considered so far.

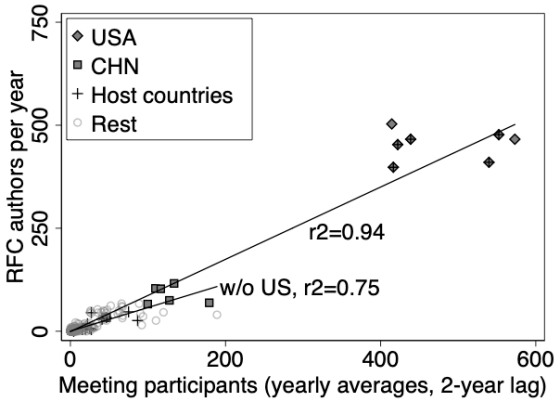
The participation-output link in the IETF

Yet, does participation matter for organizational output? We have argued that participation matters because open decision-making procedures allow participants to influence decisions. However, this assumption derives from literature rather than evidence. We cannot rely on general literature either. While scholars interested in transnational participation tend to imply that changes in participation would affect decisions, there are, to our knowledge, no systematic analyses of this participation-output link (see Kahler 2017:167–169 for a similar point on climate governance).

We provide evidence of this link based on an analysis of authorship of the IETF's main output, RFCs. Drafting output is not the same as influence, but authors can be assumed to have non-trivial impact on the documents that carry their name. We compiled information on the 2,885 authors of all 3,308 RFCs published since 2008. Thus, we are able to assess the relationship between IETF participation and writing IETF output.

Figure 10. Participation and IETF output

a) RFCs and IETF participants



Note: The y-axis shows how often participants from a country wrote RFCs.

Figure 10 shows the results. As writing RFCs takes about two years, we lagged the variables accordingly (Simcoe 2012). We observe evidence in line with a strong participation-output link in the IETF. Even without US observations, cross-national variation in participation accounts for 70-80 percent of variation in RFC authorship. Regressions of RFC authorship on lagged participation, with country fixed effects, a lagged dependent variable, or both, with and without US observations yield the same conclusion (not shown).

We also explored whether these patterns hold in the nine countries in which participation has changed the most (see Figure A3 in the appendix). We observe a noteworthy relationship in six of nine cases (China, Finland, France, South Korea, the Netherlands, and Sweden), a weaker relationship in one (Japan), and no relationship in two (Germany and the United Kingdom). We take this as further reason to conclude that IETF participation and output are linked.

A possible objection is that RFCs are a heterogeneous group of publications. They include the IETF's crucial Internet Standards and technical commentary (i.e. informational and experimental RFCs). It would be mistaken to conclude that technical commentary is unimportant as it can become widely discussed, but standards are more impactful as they tend to become widely applied. Thus, we also examined the 64 authors of the 29 Internet Standards produced since 2008 (Figure A4 in the appendix). While the data are too sparse for cross-national relationships, they make clear that Internet Standards come nearly exclusively from countries with many IETF participants, and mainly the USA. Authors come from organizations in ten countries (Canada, China, France, Germany, Israel, Spain, Sweden, Switzerland, United Kingdom, and USA).

We acknowledge that a comprehensive explanation of influence on IETF decisions would have to go beyond output and require further variables. However, for our purposes, it is not essential to determine conclusively how much influence RFC authors actually have on their own products, or whether participation directly causes standards production. Probably, additional factors shape the decision-making process. The findings here show a sufficiently strong input-output relationship in the IETF to be skeptical of any claims that participation is not relevant—certainly in conjunction with the depiction of the IETF's decision-making procedures in the existing literature.

Conclusion

We set out to explain cross-national variation in participation in transnational internet governance. The participants in key arenas, such as the IETF that we study here, increasingly make politically significant choices, yet little is known about who participates and how participation varies. Embedding our argument in general literature on transnational governance, we have argued that resource-based and institutional explanations help explain internet governance participation (Dingwerth 2008; Andonova et al. 2017; Kahler 2017; Roger et al. 2017). Yet, we have also highlighted the underappreciated role of information patronage by transnational leaders. By disseminating information on effective participation, leaders reinforce selective involvement in favor of their networks and contribute to path-dependent transnational participation.

Our results, based on new participation and leadership data for the IETF, are consistent with the proposed relationship between transnational leadership and participation. The findings also support the common view that domestic economic and technological development and liberal political institutions facilitate transnational participation. However, political freedoms seem to be more relevant than economic freedoms. These two types of domestic freedom are often considered together in the literature (Stephen 2014) but might relate differently to transnational governance. This is relevant given that countries might have different approaches to economic and political liberalization. Finally, our results are in line with so far untested claims that variation in transnational participation actually affects transnational output.

For the growing literature on participation in transnational governance arenas, our study suggests a new variable and mechanism—the distribution of leadership positions and information patronage. More generally, existing explanations of cross-national variation in participation often focus on domestic factors, whereas characteristics of the transnational arenas in question might be important in addition. Our argument could be tested in other contexts and developed further by examining alternative mechanisms of leadership selection and their implications for the persistence of leaders and participants over time. Other transnational, explanatory factors including the transparency and openness of access rules that Stephen (2014) alludes for elite networks or the participatory mechanisms that Dingwerth (2008) finds could be operationalized more systematically and tested as to their participatory effects across and within governance arenas.

Our results have implications for the legitimacy of transnational governance, which faces challenges fueled by perceptions of underrepresentation (Newman and Zala 2018). Aggrieved by the limited role of actors from their jurisdictions countries including Brazil, China, India, Iran, and Russia advocate intergovernmental forms of internet governance (Glen 2014). More generally, while many of these countries have become normal participants of intergovernmental organizations, they remain skeptical of transnational processes perceived to benefit "Western" actors (Dingwerth 2008; Kahler 2013). An important question is whether economic and technological catching-up will lead to greater involvement from these countries and alleviate legitimacy challenges. Our analysis warrants caution. In internet governance, participation does not only depend on domestic conditions, but also on transnational factors, such as patronage by the leaderships of existing arenas. Even significant catching-up processes at the national level are therefore unlikely to resolve participation discrepancies entirely or quickly.

Incidentally, our analysis sheds light on the role of China in these debates. China is often considered one among other emerging economies and said to face similar issues in transnational governance. Yet, recent work finds that China is an outlier in climate governance (Kahler 2017:161–162). We find that it differs from other less wealthy and free countries in internet governance. Others highlight the special role of China in other areas of technology governance (Fu and Gong 2011; Contreras 2014; Xia 2017). This need not be surprising given Chinese resources and ambitions (Altenburg, Schmitz, and Stamm 2008; Vialle, Song, and Zhang 2012; Galloway and Baogang 2014). However, it suggests that China might not remain an ally for other countries aggrieved by

weak transnational representation—as the participation of Chinese actors grows, the Chinese government's view might grow more favorable as well.

Finally, our results indicate new perspectives on policy bias in transnational governance. Transnational arenas are sometimes said to display certain policy tendencies. This argument is relevant not only in other areas of technology governance and standard setting. It also matters in research on epistemic communities and elite networks more broadly that share and might seek to spread policy recommendations (Carroll and Carson 2003; Cross 2013). For example, IETF participants have been found to display relatively homogenous preferences against the inclusion of governments in internet governance and the use of internet infrastructure for governmental goals such as surveillance (de Nardis 2015; Rachovitsa 2016). Mechanisms that ensure selectivity and continuity in the composition of transnational arenas, such as leadership patronage, might help explain why such policy biases can persist even in diverse and weakly hierarchical environments.

References

ALTENBURG, TILMAN, HUBERT SCHMITZ, and ANDREAS STAMM. (2008) Breakthrough? China's and India's Transition from Production to Innovation. *World Development* 36: 325–344.

ANDONOVA, LILIANA B., MICHELE M. BETSILL, and HARRIET BULKELEY. (2009) Transnational Climate Governance. *Global Environmental Politics* 9: 52–73.

ANDONOVA, LILIANA B., THOMAS N. HALE, and CHARLES B. ROGER. (2017) National Policy and Transnational Governance of Climate Change: Substitutes or Complements? *International Studies Quarterly* 61: 253–268.

BECKER, MANUEL. (2019) When Public Principals Give up Control over Private Agents: The New Independence of ICANN in Internet Governance. *Regulation & Governance*. Available at: https://onlinelibrary.wiley.com/doi/abs/10.1111/rego.12250. (Accessed July 6, 2019).

BERKMAN CENTER FOR INTERNET & SOCIETY. (2010) Accountability and Transparency at ICANN: An Independent Review.

BEXELL, MAGDALENA, JONAS TALLBERG, and ANDERS UHLIN. (2010) Democracy in Global Governance: The Promises and Pitfalls of Transnational Actors. *Global Governance* 16: 81–101.

BRADNER, S. (1996) The Internet Standards Process -- Revision 3 (RFC 2026). Available at: https://tools.ietf.org/html/rfc2026.

BRADSHAW, SAMANTHA, and LAURA DENARDIS. (2018) The Politicization of the Internet's Domain Name System: Implications for Internet Security, Universality, and Freedom. *New Media & Society* 20: 332–350.

CARR, MADELINE. (2015) Power Plays in Global Internet Governance. *Millennium* 43: 640–659.

CARROLL, WILLIAM K., and COLIN CARSON. (2003) The Network of Global Corporations and Elite Policy Groups: A Structure for Transnational Capitalist Class Formation? *Global Networks* 3: 29–57.

CLAPP, JENNIFER. (1998) The Privatization of Global Environmental Governance: ISO 14000 and the Developing World. *Global Governance* 4: 295–316.

CLARK, DAVID D. (1992) A Cloudy Crystal Ball: Visions of the Future. In *24th Meeting of the Internet Engineering Task Force*, Cambridge, MA, 13-17 July 1992.

CONTRERAS, JORGE L. (2014) Divergent Patterns of Engagement in Internet Standardization: Japan, Korea and China. *Telecommunications Policy* 38: 914–932.

CONTRERAS, JORGE L. (2008) Talking with Jorge L. Contreras. *IETF Journal*. Available at: https://www.ietfjournal.org/talking-with-jorge-l-contreras/. (Accessed July 25, 2019).

CROSS, MAI'A K. DAVIS. (2013) Rethinking Epistemic Communities Twenty Years Later. *Review of International Studies* 39: 137–160.

DINGWERTH, KLAUS. (2008) Private Transnational Governance and the Developing World: A Comparative Perspective. *International Studies Quarterly* 52: 607–634.

VAN EETEN, MICHEL J. G., and MILTON MUELLER. (2013) Where Is the Governance in Internet Governance? *New Media & Society* 15: 720–736.

FROOMKIN, A. MICHAEL. (2003) Habermas@discourse.Net: Toward a Critical Theory of Cyberspace. *Harvard Law Review* 116: 749–873.

FU, XIAOLAN, and YUNDAN GONG. (2011) Indigenous and Foreign Innovation Efforts and Drivers of Technological Upgrading: Evidence from China. *World Development* 39: 1213–1225.

FU, XIAOLAN, CARLO PIETROBELLI, and LUC SOETE. (2011) The Role of Foreign Technology and Indigenous Innovation in the Emerging Economies: Technological Change and Catching-Up. *World Development* 39: 1204–1212.

GALLOWAY, TRISTAN, and HE BAOGANG. (2014) China and Technical Global Internet Governance: Beijing's Approach to Multi-Stakeholder Governance within ICANN, WSIS and the IGF. *China: An International Journal* 12: 72–93.

GAO, PING, JIANG YU, and KALLE LYYTINEN. (2014) Government in Standardization in the Catching-up Context: Case of China's Mobile System. *Telecommunications Policy* 38: 200–209.

GLEN, CAROL M. (2014) Internet Governance: Territorializing Cyberspace? *Politics & Policy* 42: 635–657.

HALE, THOMAS, and CHARLES ROGER. (2014) Orchestration and Transnational Climate Governance. *The Review of International Organizations* 9: 59–82.

HOFMANN, JEANETTE. (2016) Multi-Stakeholderism in Internet Governance: Putting a Fiction into Practice. *Journal of Cyber Policy* 1: 29–49.

INTERNET SOCIETY. (2016) Support for the Timely Transition of IANA Stewardship. Available at: https://www.internetsociety.org/wp-content/uploads/2017/08/1IANACongress-Letter-2016-09-1220281292028129.pdf.

KAHLER, MILES. (2017) Domestic Sources of Transnational Climate Governance. *International Interactions* 43: 156–174.

KAHLER, MILES. (2013) Rising Powers and Global Governance: Negotiating Change in a Resilient Status Quo. *International Affairs* 89: 711–729.

KOPPELL, JONATHAN G. S. (2005) Pathologies of Accountability: ICANN and the Challenge of "Multiple Accountabilities Disorder." *Public Administration Review* 65: 94–108.

KUCHERAWY, MURRAY S. (2015) IAB, IESG, and IAOC Selection, Confirmation, and Recall Process: Operation of the Nominating and Recall Committees (RFC 7437. Available at: https://tools.ietf.org/html/bcp10.

MARSAN, CAROLYN D. (2017) Today's IETF Leaders: Mirja Kühlewind, PhD. *IETF Journal*. Available at: https://www.ietfjournal.org/todays-ietf-leaders-mirja-kuhlewind-phd/. (Accessed July 25, 2019).

MARSHALL, MONTY G., K. JAGGERS, and TED ROBERT GURR. (2011) The Polity IV Project - Political Regime Characteristics and Transitions, 1800-2010.

MATHIASON, JOHN. (2009) *Internet Governance: The New Frontier of Global Institutions*. Abington: Routledge.

MATTLI, WALTER, and TIM BÜTHE. (2003) Setting International Standards: Technological Rationality or Primacy of Power? *World Politics* 56: 1–42.

MCELREATH, RICHARD. (2015) *Statistical Rethinking: A Bayesian Course with Examples in R and Stan*. Boca Raton, FL: Chapman and Hall/CRC.

MOONESAMY, S. (2014) IETF Guidelines for Conduct.

MUELLER, MILTON. (2010) *Networks and States: The Global Politics of Internet Governance*. Cambridge, MA: The MIT Press.

DE NARDIS, LAURA. (2012) Hidden Levers of Internet Control. *Information, Communication & Society* 15: 720–738.

DE NARDIS, LAURA. (2009) *Protocol Politics: The Globalization of Internet Governance*. Cambridge, MA: MIT Press.

DE NARDIS, LAURA. (2014) *The Global War on Internet Governance*. New Haven: Yale University Press.

DE NARDIS, LAURA. (2015) The Internet Design Tension between Surveillance and Security. *IEEE Annals of the History of Computing* 37: 72–83.

NAUGHTON, JOHN. (2016) The Evolution of the Internet: From Military Experiment to General Purpose Technology. *Journal of Cyber Policy* 1: 5–28.

NEWMAN, EDWARD, and BENJAMIN ZALA. (2018) Rising Powers and Order Contestation: Disaggregating the Normative from the Representational. *Third World Quarterly* 39: 871–888.

NÖLKE, ANDREAS, TOBIAS TEN BRINK, SIMONE CLAAR, and CHRISTIAN MAY. (2015) Domestic Structures, Foreign Economic Policies and Global Economic Order: Implications from the Rise of Large Emerging Economies. *European Journal of International Relations* 21: 538–567.

NYE JR., JOSEPH S. (2014) The Regime Complex for Managing Global Cyber Activities.

TEN OEVER, NIELS, and KATHLEEN MORIARTY. (2018) The Tao of IETF: A Novice's Guide to the Internet Engineering Task Force (Version 2018-11-08). Available at: https://www.ietf.org/about/participate/tao.

PLÜMPER, THOMAS, VERA E. TROEGER, and PHILIP MANOW. (2005) Panel Data Analysis in Comparative Politics: Linking Method to Theory. *European Journal of Political Research* 44: 327–354.

POST, DAVID G., and DANIELLE KEHL. (2015) Controlling Internet Infrastructure: The 'IANA Transition' and Why It Matters for the Future of the Internet. Available at: https://static.newamerica.org/attachments/2964-controlling-internet-infrastructure/IANA_Paper_No_1_Final.32d31198a3da4e0d859f989306f6d480.pdf.

POWERS, SHAWN M., and MICHAEL JABLONSKI. (2015) *The Real Cyber War*. Urbana, Chicago: University of Illinois Press.

RACHOVITSA, ADAMANTIA. (2016) Engineering and Lawyering Privacy by Design: Understanding Online Privacy Both as a Technical and an International Human Rights Issue. *International Journal of Law and Information Technology* 24: 374–399.

RAYMOND, MARK, and LAURA DE NARDIS. (2015) Multistakeholderism: Anatomy of an Inchoate Global Institution. *International Theory* 7: 572–616.

RESNICK, P. (2014) On Consensus and Humming in the IETF.

ROGER, CHARLES, and PETER DAUVERGNE. (2016) The Rise of Transnational Governance as a Field of Study. *International Studies Review* 18: 415–437.

ROGER, CHARLES, THOMAS HALE, and LILIANA ANDONOVA. (2017) The Comparative Politics of Transnational Climate Governance. *International Interactions* 43: 1–25.

ROGERS, MICHAEL, and GRACE EDEN. (2017) The Snowden Disclosures, Technical Standards, and the Making of Surveillance Infrastructures. *International Journal of Communication* 11: 802–823.

RUSSELL, ANDREW L. (2014) *Open Standards and the Digital Age*. New York: Cambridge University Press.

RUSSELL, ANDREW L. (2006) "Rough Consensus and Running Code" and the Internet-OSI Standards War. *IEEE Annals of the History of Computing* 28: 48–61.

SIMCOE, TIMOTHY. (2012) Standard Setting Committees: Consensus Governance for Shared Technology Platforms. *The American Economic Review* 102: 305–336.

STAN DEVELOPMENT TEAM. (2016) RStan: The R Interface to Stan. R Package Version 2.16.2, Http://Mc-Stan.Org/.

STEPHEN, MATTHEW D. (2014) Rising Powers, Global Capitalism and Liberal Global Governance: A Historical Materialist Account of the BRICs Challenge. *European Journal of International Relations* 20: 912–938.

ST.JOHNS, MIKE. (2006) Interview with Mike St.Johnes, Director Network Implementation Strategies, Nominet. *IETF Journal*. Available at: https://www.ietfjournal.org/interview-with-mike-st-johnes-director-network-implementation-strategies-nominet/. (Accessed July 25, 2019).

TAKE, INGO. (2012) Regulating the Internet Infrastructure: A Comparative Appraisal of the Legitimacy of ICANN, ITU, and the WSIS. *Regulation & Governance* 6: 499–523.

TALLBERG, JONAS, THOMAS SOMMERER, THERESA SQUATRITO, and CHRISTER JÖNSSON. (2013) *The Opening Up of International Organizations*. Cambridge: Cambridge University Press.

VIALLE, PIERRE, JUNJIE SONG, and JIAN ZHANG. (2012) Competing with Dominant Global Standards in a Catching-up Context. The Case of Mobile Standards in China. *Telecommunications Policy* 36: 832–846.

WEINBERG, JONATHAN. (2000) ICANN and the Problem of Legitimacy. *Duke Law Journal* 50: 187–260.

XIA, JUN. (2017) China's Telecommunications Evolution, Institutions, and Policy Issues on the Eve of 5G: A Two-Decade Retrospect and Prospect. *Telecommunications Policy* 41: 931–947.

Appendix

Content

Additional tables and figures

Table A1. IETF meetings

Meeting	City	Participants	Organizations	Countries
1	Dublin	1153	436	46
2	Mineapolis	859	340	38
3	San Francisco	1158	425	44
4	Stockholm	1088	418	51
5	Hiroshima	1082	354	46
6	Anaheim	1194	440	51
7	Maastricht	1156	420	50
8	Beijing	1076	346	49
9	Prague	1142	407	46
10	Quebec	1076	395	43
11	Taipei	827	299	48
12	Paris	1309	463	53
13	Vancouver	1152	433	58
14	Atlanta	1122	400	58
15	Orlando	1034	359	48
16	Berlin	1353	476	64
17	Vancouver	1138	413	61
18	London	1317	464	64
19	Honululu	1162	410	48
20	Dallas	1229	460	61
21	Prague	1314	473	61
22	Yokohama	1229	397	47
23	Buenos Aires	1364	489	61
24	Berlin	1493	564	63
25	Seoul	1103	436	63
26	Chicago	1285	518	72
27	Prague	1484	584	69

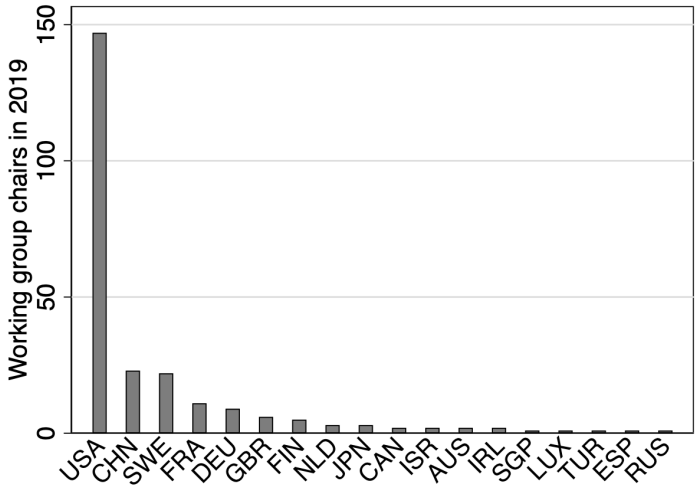
Note: This table shows all meetings in our data from 2008-2017.

Table A2. Average participants by country and affiliation

Country	Companies	Civil societies	Public actors	Technical community	Academic institutions
USA	373	22	19	59	27
EU	180	15	7	26	66
China	92	1	7	5	20
Japan	77	0	0	7	21
Rest	59	7	16	20	55

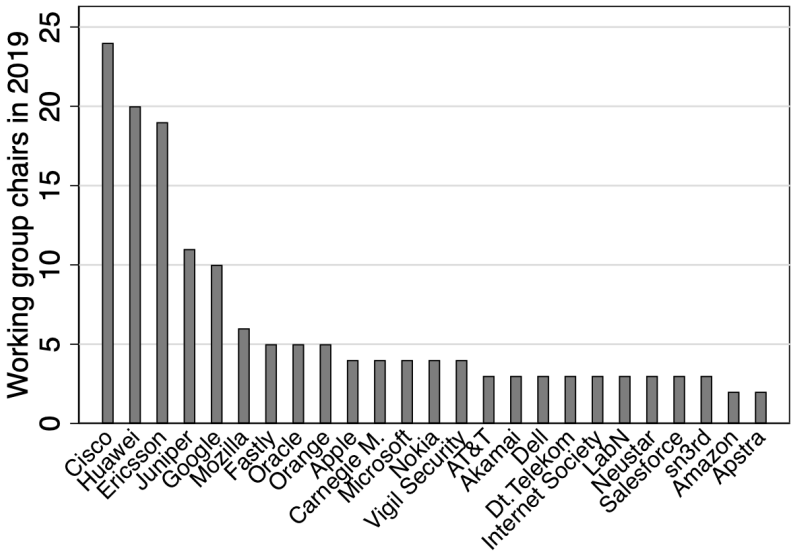
Note: The entries are average participants per IETF meeting. Figure 4 draws on this table.

Figure A1. Working group chairs in 2019 by country



Note: The figure shows working group chairs in spring 2019 based on the country location of their organizations.

Figure A2. Working group chairs from different organizations



Note: The figure only shows the 25 companies with most working group chairs.

Table A3. Summary statistics

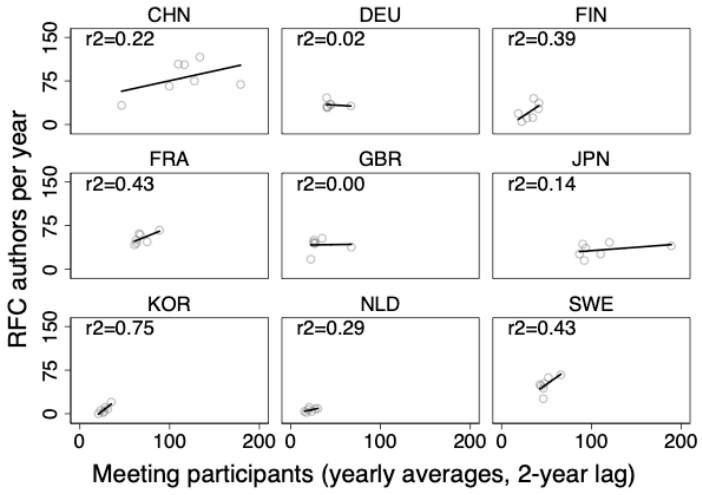
a) All observations

Variable	Obs.	Mean	Std.	Min.	Max.
Participants	3,600	8.09	45.03	0	649
Participants (Companies)	3,600	5.38	33.33	0	476
Participants (Civil society)	3,600	0.30	2.06	0	33
Participants (Public)	3,600	0.33	1.90	0	35
Participants (Technical community)	3,600	0.79	5.18	0	92
Participants (Academic institutions)	3,600	1.28	5.41	0	101
GDP per capita (log)	3,527	8.64	1.54	5.28	11.69
ICT service exports (log)	2,891	-0.05	2.56	-7.80	5.18
Distance to IETF meeting (log)	3,600	8.76	0.79	5.30	9.90
IETF meeting host	3,600	0.01	0.08	0	1
Polity index	3,452	4.07	6.32	-10	10
Economic Freedom index	3,200	6.84	0.85	2.88	9.20
IETF working group chairs (continuous)	3,600	1.71	11.88	0	163
IETF working group chairs: None	3,600	0.86	0.35	0	1
IETF working group chairs: Few (1-4)	3,600	0.08	0.27	0	1
IETF working group chairs: Many (5+)	3,600	0.06	0.24	0	1
USA	3,600	0.01	0.08	0	1
China	3,600	0.01	0.08	0	1
EU	3,600	0.17	0.38	0	1
November	3,600	0.36	0.48	0	1

b) Shared observations (estimation sample)

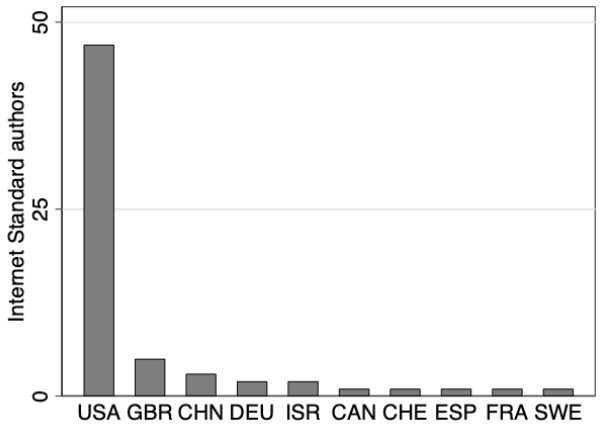
Variable	Obs.	Mean	Std.	Min.	Max.
Participants	2,627	10.45	51.97	0	649
Participants (Companies)	2,627	7.05	38.67	0	476
Participants (Civil society)	2,627	0.39	2.39	0	33
Participants (Public)	2,627	0.41	2.15	0	35
Participants (Technical community)	2,627	1.05	6.01	0	92
Participants (Academic institutions)	2,627	1.54	5.53	0	88
GDP per capita (log)	2,627	8.81	1.51	5.56	11.69
ICT service exports (log)	2,627	0.20	2.48	-7.80	5.18
Distance to IETF meeting (log)	2,627	8.73	0.85	5.30	9.90
IETF meeting host	2,627	0.01	0.09	0	1
Polity index	2,627	5.48	5.50	-10	10
Economic Freedom index	2,627	6.93	0.80	3.32	9.20
IETF working group chairs (continuous)	2,627	2.26	13.83	0	163
IETF working group chairs: None	2,627	0.83	0.37	0	1
IETF working group chairs: Few (1-4)	2,627	0.10	0.29	0	1
IETF working group chairs: Many (5+)	2,627	0.08	0.27	0	1
USA	2,627	0.01	0.10	0	1
China	2,627	0.01	0.09	0	1
EU	2,627	0.21	0.41	0	1
November	2,627	0.36	0.48	0	1
Countries	124				
Meeting	25				
Years	9				

Figure A3. Participation and RFC authorship in selected countries



Note: The y-axis shows how often participants from a country (co-)authored Request for Comments documents.

Figure A4. Internet Standards: Authors by country since 2008



Note: The y-axis shows how often participants from a country (co-)authored final Internet Standards.

Further discussion of the statistical Model

All three models in the manuscript (Figure 7) are estimated in a Bayesian framework. Moreover, the third model introduces a country-level random effect. Here, we explain these choices further.

We implement the third, hierarchical model in order to accommodate the fact that our observations are encapsulated within countries. The discussion of how to approach these clusters can be framed in terms of whether or not to pool information across them. No pooling would mean to use fixed effects for countries and meetings and rely only on within-cluster information. This approach risks overfitting the data and depletes variation, especially in contexts with limited longitudinal variation.(e.g. Plümper, Troeger, and Manow 2005) Full pooling ignores the clusters and is prone to underfitting the data.(e.g. McElreath 2015:364–370) We opted for the middle ground of a hierarchical model that uses varying parameters to partially pool information across groups of observations (i.e. random effects). We use hyperparameters to let the model learn the amount of pooling from the data.

Our data are counts of the number of participants per country and meeting. Therefore, a count model is appropriate. However, compared to the standard Poisson distribution, the participation outcomes are overdispersed and contain many zeros. In this case, the literature recommends using either a negative binomial distribution, which addresses overdispersion but not excess zeros, or the inclusion of observation-level random intercepts in a Poisson-based hierarchical model.(e.g. McElreath 2015:355–386) We follow the second option since it accommodates deviations from the Poisson distribution flexibly. We fit the following model (this is the hierarchical form as in model 3. Only the main explanatory variables are shown):

$$
\begin{aligned}
&\text{Participation}_i \sim \text{Poisson}(\lambda_i),\\
&\text{Log}(\lambda_i) = \alpha + \alpha_{[i]} + \alpha_{\text{country}[j]} + \alpha_{\text{meeting}[k]} +\\
&\qquad \beta_1 * \text{Log ICT service exports}_i +\\
&\qquad \beta_2 * \text{Polity index}_i +\\
&\qquad \beta_3 * \text{Economic freedoms}_i +\\
&\qquad \beta_4 * \text{Working group chairs}_i,\\
&\alpha \qquad \sim \text{Normal}(0, 2),\\
&\alpha_{[i]} \qquad \sim \text{Normal}(0, \sigma_i),\\
&\alpha_{\text{country}[j]} \qquad \sim \text{Normal}(0, \sigma_{\text{country}}),\\
&\beta_1\text{-}\beta_4 \qquad \sim \text{Normal}(0, 2),\\
&\sigma_i \qquad \sim \text{Normal}(0, 1) \;\&\; \sigma_i >= 0,\\
&\sigma_{\text{country}} \qquad \sim \text{Normal}(0, 1) \;\&\; \sigma_{\text{country}} >= 0.
\end{aligned}
$$

This model draws debate observations from a Poisson distribution with central tendency λ. Lambda, through a log-link, is conceived of as a linear function of the explanatory variables, a global intercept α as well as the observation and country intercepts. These intercepts are themselves drawn from distributions with variances σ_i and σ_{country}. These so-called hyperparameters determine how much pooling across clusters occurs in the model. If they are large, the random intercepts become similar to fixed effects. The hyperparameters are themselves estimated from the data. Their

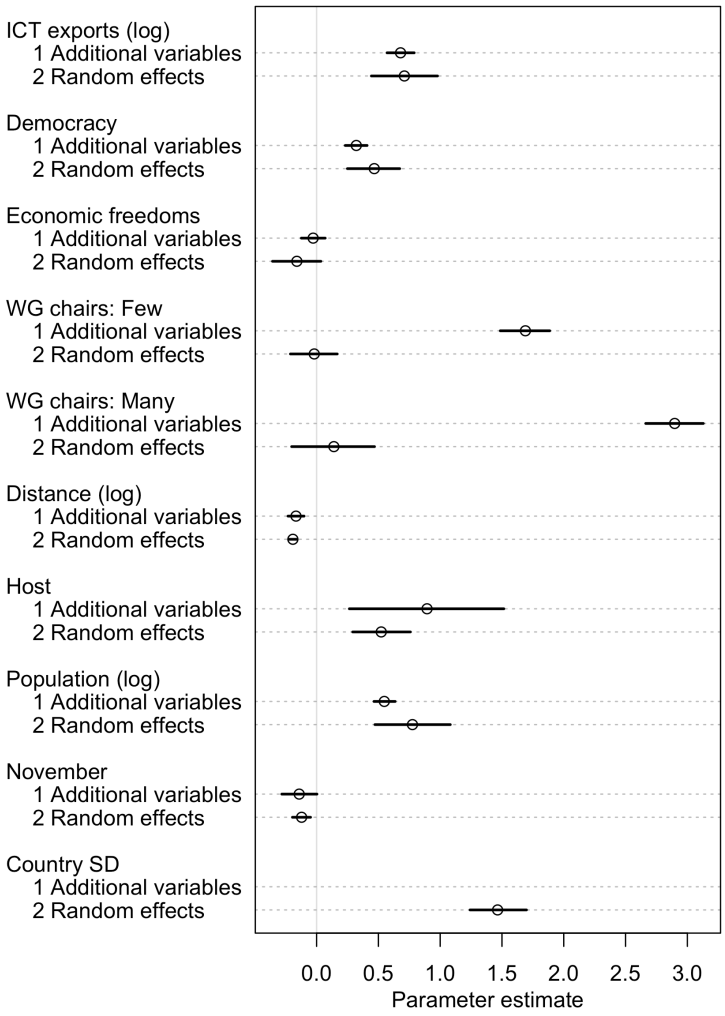
size depends on the strength of clustering in the data. We make mildly regularizing prior assumptions centered on zero—i.e. no relationship between the variables and outcome.

We fit the model relying on RStan and tools by McElreath. (McElreath 2015; Stan Development Team 2016) Speficially, we explore the posterior distribution of the models on the basis of four Monte Carlo Markov chains with 5000 steps (including 1500 warm up) each. We examined trace plots and the potential scale reduction factor and concluded that all chains converged. Posterior predictive checks showed good model fit.

Additional analyses of variation in participation

We conducted additional analyses to explore the robustness of the results in the section "Bivariate and multivariate relationships". The first question, in light of the exceptional share of US participants and leaders, is whether US observations drive the results. Yet, we repeated our analyses without US observations and obtained very similar results (Figure A5).

Figure A5. Results without US observations

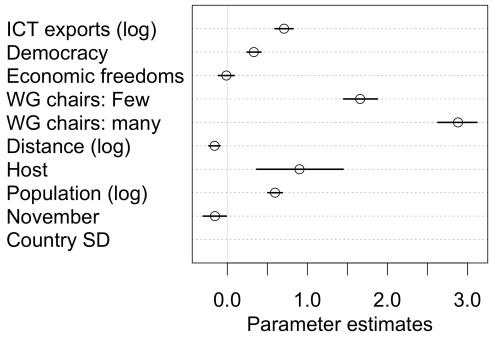


Note: The models rely on 2,602 observations from 123 countries and 25 IETF meetings. The bars show 95%-Highest Posterior Density Intervals. Compare these results to the models 2 and 3 in Figure 7 in the manuscript.

Another issue is that the main analysis examines IETF participation from 124 countries. However, for some of these countries, we lack data on the explanatory variables for many IETF meetings. To check whether this influences the results, we reduced our sample to the 95 countries for which we

have data on all variables for at least 20 IETF meetings. However, as Figure A6 shows, the results do not depend on the composition of the sample.

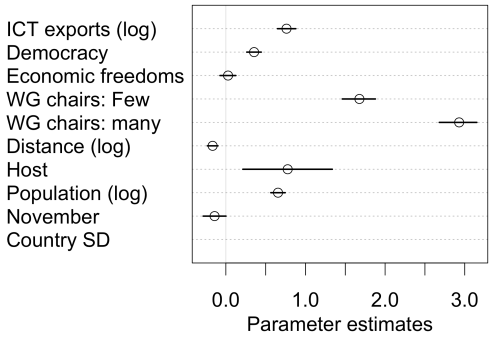
Figure A6. Results in a balanced sample



Note: The figure shows results from the same model as model 2 in Figure 7, but only with observations from countries for which we have data on all variables for at least 20 IETF meetings. This leaves 2,233 observations from 95 countries.

A related concern is that our analysis only includes countries that had at least one IETF participant in the 27 meetings in our data. While this approach encompasses 144 countries (and 123 given missing information for the explanatory variables) and all major economies, it could be argued that participants could come from any country. The relevant population of cases would then be all countries rather than those that have had at least one participant. On the other hand, including all countries merely creates about 400 more new "zeros" (from 20 countries). To examine this issue, we repeated the analysis with all countries covered by the World Bank. The results, summarized in Figure A7, change hardly at all.

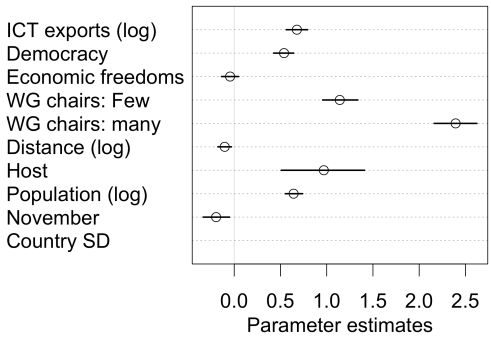
Figure A7. Results in an enlarged country sample



Note: The figure shows results from the same model as model 2 in Figure 7, but based on a broader population of countries (142), and 3,004 observations.

A final concern is that our findings reflect the discrepancy between wealthy and poor countries, which constitute a significant part of the data but have few IETF participants. To test this possibility, we reduced our sample to countries with above-average levels of GDP/capita—leaving participants from 67 or our original 124 countries. As Figure A8 shows, this weakens the relationship between participation and working group chairs a little but not to an extent that would warrant any different conclusions.

Figure A8. Results in a sample of wealthy countries



Note: The figure shows results from the same model as model 2 in Figure 7, but only including participation from countries with above-average levels of GDP/capita. This leaves 1,466 observations from 67 countries.