Measuring information performance of international institutions: the Trade Policy Review Mechanism of the World Trade Organization 1995–2014

Michal Parízek, Charles University*

A first and preliminary draft. Please do not cite or quote. Paper submitted in application for the 10th PEIO Conference, January 12-14, 2017, Bern. Submission date: September 30, 2016.

Abstract

Building on information theory, I develop a framework for the assessment of the amount of information flowing through international institutions. I present the core concept of information theory – that of information entropy – as a measure of information contained in political communication. I illustrate the features of the framework developed here by applying it to a large new dataset capturing state's communication within the World Trade Organization (WTO) Trade Policy Review Mechanism (TPRM) in the years 1995–2014. Empirically, I identify a major upwards trend in the amount of information flowing within the Mechanism. Furthermore, I argue that this trend can be linked to the problems of the legalized WTO rule-making pillar, suggesting a shift of the global trade regime towards softer, non-legalized modes of cooperation.

Keywords: Information, Information Theory, International Institutions, Performance, World Trade Organization, Trade Policy Review Mechanism

Wordcount: approx. 10 500 words

*Contact: michal.parizek@fsv.cuni.cz

1 Introduction

How global problems are dealt with depends, in large part, on the functioning of the major global institutions, such as the WTO, the International Monetary Fund, the institutions of the climate regime, or the United Nations and its Security Council. But in the views of many, these institutions do not work well, and they are bound to face further problems in the future, resulting from the ascent of the so-called rising powers, with presumably significantly different preferences than are those of the so-called established powers (cf. Ikenberry, 2011; Kahler, 2013; Narlikar, 2013; Stephen, 2014). In the world of (increasingly salient) conflicts of interests of the major systemic powers, institutionalized international cooperation is likely to be ever more difficult to achieve and sustain and the institutions may be unable to perform their function. It seems to be a legitimate task for scholars of international relations to seek the conditions under which the international institutions could indeed contribute to cooperation, the harsher conditions, compared e.g. to 1990s, notwithstanding.

In this text I introduce a framework for the assessment of institutions' performance based on their fundamental information transmission function. I argue that an assessment of how international institutions work need consider neither their ultimate effectiveness (cf. Helm & Sprinz, 2000), nor behavioral outcomes understood as rule-compliance (e.g. Raustiala & Slaughter, 2002), nor political output (Tallberg *et al.*, 2016). Instead, I propose to focus on one specific, yet fundamental aspect of the institutions' performance, namely on how they enable and ensure the proper flow of information among the cooperating parties. Zooming in on the most immediate effect the institutions have on international cooperation, rather than on the more distant political outputs, behavioral outcomes, or physical effects (cf. Young, 2001), enables us to focus on the institution as such and to some extent isolate such factors as power and interest distributions. Such an approach – minimizing the length of the causal link – should lead to new insights into the effects of various institutional factors, including design, on the institutions' performance (cf. Gutner & Thompson, 2010).

Building on information theory, as formulated at its core since late 1940s, I develop a framework for the assessment of the amount of information flowing through international institutions. I present the core concept of information theory – that of the so-called (Shannon) entropy – as a measure of information contained in a message. I show how such a concept can be applied in the study of political communication within international institutions. What results is a rigorous, formalized, yet intuitively plausible framework for the assessment of how cooperating states communicate in governance bodies.

In order to demonstrate the use of such a framework, I apply it to the case of the World Trade Organization and its Trade Policy Review Mechanism (TPRM). Building on a large new dataset covering the working of the TPRM in years 1995 – 2014, I demonstrate the presence of a major upwards trend in the amount of information flowing through the Mechanism. A more nuanced look, however, reveals that the trend is really prominent only after around 2003. Hence, it seems to be closely attributable to the problems of the rule-making pillar of the WTO. As a result, I argue that the observed development in the WTO indicate a possible shift from a focus on the legalization of the relationship among members to the focus (back) on 'mere' information sharing and reputation building, as the building blocks of cooperation formulated in the original cooperation theory. In the context of the WTO, this fundamental function of international institutions is embodied in the TPRM, while the more advanced and demanding functions are embodied in the legalized rule-making and dispute settlement pillars.

The articles is structured as follows. First, I provide a brief conceptual discussion of the notion of international institutions as information mechanism, based on the review of the existing literature. Second, I outline the framework for the measurement of information in political communications. Third, I apply this framework to the data from the TPRM in the year 2014, to illustrate its core features and operational applicability. Finally, I present the evidence of the trends in the information flows through the TPRM, over the course of the WTO's existence.

2 International institutions as information mechanisms

International institutions are information mechanisms. Some of the most fundamental debates in the history of IR concern the possibility of cooperation among individual rational (egoistic) states, and the principal finding of this debate is that cooperation may be possible but that for it to emerge and sustain a number of conditions must be fulfilled. The role of institutions, as observed by Keohane and others (Keohane, 1984) is to facilitate cooperation by providing better access to higher quality and credibility information (cf. Axelrod & Keohane, 1985).

The very core of this notion can be found already in the debate about international regimes understood as "principles, norms, rules, and decision-making procedures around which actor expectations converge in a given issue-area" (Krasner, 1982, p. 185). The causal mechanism through which the regime impacts on the cooperation lies in the change in the actors expectations, or in the provision of additional information that allows them to align their behaviour. Similarly, the functional theory of regimes makes it explicit that information provision is the core function of institutions. After all, cooperation can emerge only when the states trust they would not be cheated upon (Axelrod, 1981). The concrete mechanisms that enable it are, hence, reputation building, itself based on the development of shared understandings of standard/appropriate behaviour and on the availability of effective monitoring mechanisms (cf. Dai, 2002).

This notion of international institutions as information mechanisms is implicitly present in countless scholarly works, and in many it forms their conceptual and theoretical core. Notable examples include the works of Helen Milner (Milner, 1997), Ronald Mitchell (Mitchell, 1994, 1998), James Morrow (Morrow, 1994, 2001), or Alex Thompson (Thompson, 2006).

To a large extent, the newer literature on international institutions and especially organizations, based on the principal-agent framework, focuses on information transmission problems as well. One key area is the problem of the monitoring of IOs (cf. Hawkins *et al.*,

2006), as discussed for example by Lisa Martin for the case of the IMF (Martin, 2006). The very notion of the control of the IOs by their principals rests on the informational logic (Dijkstra, 2015). At the same time, for the central bodies of IOs to function well it is often also key to possess information about their members (Parízek, 2016). Considerable research on transnational actors' access to IOs point to the operation of this informational logic as well (Tallberg *et al.*, 2014; Böhmelt, 2012).

In sum, many scholars work with the notion of institutions as information mechanisms. Yet, the downside of such a broad notion of institutions is in its vagueness. Even if we do admit that at the deepest level institutions are information mechanisms, does this translate into a productive research agenda? How do we assess the extent to which specific institutions carry, or enable the transmission of, politically relevant information?

3 Measuring the information content of a message

In this section, I outline the core of the framework for the measurement of information content, based on the original definitions of the information theory, with small adjustments for the applicability to political communication. In presenting it, I rely primarily on the first treatise of this problem by Claude Shannon (Shannon & Weaver, 1963) and on new 'introductions' to information theory, or study materials (Cover & Thomas, 2006; Moser & Chen, 2012; Stone, 2015). I certainly cannot claim a deep competence in information theory, nevertheless the present framework builds on a limited set of rather powerful insights from this body of theory that turn out to have strong intuitive meaning, and often not overly technical.

3.1 The quantitative concept of information

The notion of information is necessarily somewhat elusive in its everyday use, but in broad terms, it corresponds to that of uncertainty, or specifically to that of the uncertainty re-

duction resulting from obtaining a message. In the archetypical communication situation, a sender is communicating a message to a receiver. The message has its physical manifestation in the specific signals that carry it, be it an electric signal sent over a circuit, a smoke of fire from a distant ancient guard tower, or a sound wave (see e.g. Gleick, 2012). The information content of the message corresponds to the level of the unpredictability of the message selected, or to "one's freedom of choice when one selects a message" (Shannon & Weaver, 1963, p. 9). If the receiver knows what message to expect, it does not carry any information when it arrives. On the other hand, the more uncertain one is about what message to expect before it is received, the more information it will carry (Fiske, 2002, p. 9).

On a technical level, the act of formulating a message by the sender corresponds to his or her choice of message(s) out of a set of possible messages, or out of an 'alphabet' from which the individual 'letter' or message is selected. Each of these messages has certain *a priori* probability of being selected. In some cases, all the possible messages $m \in M$are *a priori* equiprobable, for instance $p(m) = 0.5$ for a fair coin toss, or $p(m) = \frac{1}{6}$ for a fair dice. In these cases, the sets of possible messages – or the alphabets – correspond to $M = [heads, tails]$ and $M = [1, 2, 3, 4, 5, 6]$, respectively. Sometimes a message consists of a single signal – e.g. a letter or a number. Sometimes it can itself contain large amounts of text.

In information theory, information content of a message corresponds to its entropy (Cover & Thomas, 2006, ch. 2).[1]If we understand communication as a selection of messages from some set, it in effect corresponds to a selection from a random discrete variable. Entropy of a message, H, is then understood as the entropy of a random variables, with its probability mass function. It is defined as

[1]The information content of a message has been found to be analogous to the notion of system entropy as used in statistical mechanics in the formulation of the second law of thermodynamics. Two mathematicians – Norbert Wiener and Claude Shannon – independently arrived at such a definition of the measure of information, with a small variation (Shannon & Weaver, 1963, pp. 48-50, Wiener, 1948). Since Shannon's concept ultimately prevailed, the notion of information content is referred to as Shannon entropy or Shannon-Boltzmann entropy. Wiener's notion of entropy was formally analogous, but with an opposite sign.

$$H = -\sum_{m=1}^{M} p_m log(p_m), \tag{1}$$

where p_m is the probability of the particular letter m being selected and sent, out of the set of possible signals M. Since all $p_m < 1$ and hence all $log(p_m)$ are negative, the negative sign before the sum turns the quantity into positive. Entropy thus defined captures the amount of information transmitted, on average, with a message sent (Shannon & Weaver, 1963, p. 50).

Decomposing the formula, the information content of any message depends on two components. First, the size of the 'alphabet' M, or simply the set of possible messages the sender selects from. Naturally, the larger the 'alphabet', the more uncertainty there is as to the signal that is going to be selected, other things equal. Second, the amount of information depends on the probability distribution of the messages. It turns out that the more *a priori* equiprobable the individual possible messages m of the set M, the larger the information content carried by them. In the extreme case, if we are certain that a specific message (or a signal or 'letter' form the 'alphabet') will be selected, its $p_m = 1$ and its transmission and revelation to the receiver does not carry any information at all (see e.g. Moser & Chen, 2012, s. 5.2). The senders and the receivers may differ in their estimates of the messages probabilities, leading to the natural fact that a different amount of information may be sent by the sender than is ultimately received by the receiver. Further in the text, I illustrate how this fact can be technically incorporated into the framework.

One interesting feature of the entropy formula, as a measure of information, is that it is based on a logarithm (typically based 2, for information units 'bits'). The fact that this should be so comes as one of the large achievements of information theorists, and especially Shannon, who realized that in fact a naturally intuitive measure of information needs to be based on logarithmic transformation. Thanks to it, the measure of information contained in two equally informative messages combined is twice that of one message. Two subsequent

coin tosses contain twice as much information as a single toss (2 bits as opposed to one), even though they distinguish four times as many states of the world, namely [‘$heads - heads$’, ‘$heads - tails$’, ‘$tails - heads$’, ‘$tails - tails$’] as opposed to [‘$heads$’, ‘$tails$’]. This most desirable feature of the measure is only preserved thanks to the logarithmic form.

Note again that this definition does not say how much information has been transmitted in any specific case. For a single message, the amount of information transmitted would corresponds directly to the level of surprise communicated, hence to $log(p_i)$. The notion of entropy thus corresponds to the weighted average of the information carried by all the messages that could be sent, the weighting being by their probabilities p_i.

3.2 Communication and noise

All communication, whether social or specifically political, whether in person or mediated through electronic devices, is subject to noise, where by noise we understand “everything that corrupts the signal, predictably or unpredictably” (Gleick, 2012, p. 232). It is virtually always the case that the receiver does not receive exactly the same new information that the sender planned to send. One of the core findings of Shannon’s seminal study was to quantify the amount of information that can be transmitted via a channel of specific features, over certain period, given that certain type of noise interferes with the communication (cf. Shannon & Weaver, 1963, pp. 16-24).

In this original treatment, noise is understood virtually uniquely in technical terms, simply as a mechanical interference into the transmitted code (e.g. changing randomly the value of a transistor from off to on, distorting voice on a radio broadcast, etc.). In his extensive introduction to Shannon’s book, Weaver describes this type as engineering noise, to distinguish it from semantic noise (Shannon & Weaver, 1963, p. 26). In his sketchy outline of the difference, Weaver (and Shannon) note that while the Shannon’s framework is designed to deal with the formal aspects of communication, conceptually there is nothing

that would prevent its application also to semantics as the study of meanings.

Scores of researchers study meanings of different words and the use of language in the context of political communication, but embedding such endeavours within the framework of the formalized communication theory as developed by Shannon and others proves tedious. It is not the ambition of this text to develop a full-fledged theoretical account that would embed the problem of semantics within the formalized communication theory framework. However, it is quite natural to embed it in the framework in a non-formalized manner that nevertheless fully enables its empirical application and, most importantly, carries all the key conceptual insights.

In fact, I venture to distinguish two types of non-engineering noise in political communication, namely the semantic noise already introduced but also what I refer to as structural noise. Semantic noise, as discussed in the original theory refers to miscommunication resulting from diverging understandings of the same verbal expressions. What I refer to as structural noise describes miscommunication resulting from the situation in (a structure within) which the communication takes place. As I see it, there are two core types of such noise. First, linguistic structure noise, resulting from the limitations the language imposes on communication among political actors. Noise thus understood presents the core of research interests of many IR scholars falling under the broad labels of critical and reflexive scholarship, especially with regard to the language turn in constructivism and post-structural theory (e.g. Der Derian & Shapiro, 1998; Campbell, 1992).

Second, miscommunication can be induced by the strategic incentives of the actors, i.e. by the structure of the situation in terms of mixed or even conflictive preferences (e.g. Akerlof, 1970; Crawford & Sobel, 1982). The senders may face a credibility problem when their incentives, as perceived by the receivers, are such that communicating sincerely would hamper their interests. A sizable portion of the most influential game-theoretical applications in international politics deal with this issue (Fearon, 1994, 1995).

No matter which type of noise is present – engineering, semantic, or structural – it results

in a loss of information transmission. Conceptually, we can understand the amount of noise in the communication as the difference between the information sent and the information received, so as all the information lost on the way. In terms of the exact estimate, suppose the sender is sending a message X of entropy $H(X)$. The receiver receives a message Y of entropy $H(Y)$, presumably similar but not ncessarily the same as X. Noise amounts to the conditional entropy $H(X|Y)$ or $H(Y|X)$.[2]In other words, noise is whatever is left of one message (e.g. the one sent) once the other (the received one) is taken into account. Based on information theory, the formula for the calculation of conditional entropy $H(X|Y)$ is

$$H(X|Y) = \sum_{i}^{M} p(Y = y)H(X|Y = i). \tag{2}$$

3.3 Information actually transmitted: the mutual information

Having the three components of communication – i.e. the message sent (of entropy H(X)), the message received (of entropy H(Y)), and noise (of entropy $H(X|Y)$ or $H(Y|X)$), we can provide a quantitative formulation of the amount of information actually communicated. This amount corresponds to what in information theory is labelled as mutual information, $I(X;Y)$, where (cf. Cover & Thomas, 2006, p. 21):

$$I(X;Y) = H(X) - H(X|Y) = H(Y) - H(Y|X). \tag{3}$$

The most natural way how to calculate the amount of mutual information is with the use of probability transition matrices, depicting the joint probability mass distribution of all the possible messages m in the available 'alphabet', or set M. In other words, the transition matrices combine the information about how likely the sender is to select the particular message m, combined with the information on how likely the receiver is actually to receive the messages, given the noise intervening in the communication.

[2] $H(X|Y) \neq H(Y|X)$ in general. See Cover & Thomas, 2006, ch. 2.

In table 1, I present an example where two actors are communicating a message, using an alphabet size of 4, $M = [0, 1, 2, 3]$. The table provides the join probability mass distribution. Naturally, most probability mass is located on the main diagonal, so that once certain message is selected by the sender, it is relatively likely that it will be received by the receiver. However, there is some amount of error, so that, for example, when the sender selects message '0', the receiver has a $\frac{1}{8}$ chance of receiving message '1' and only a $\frac{7}{8}$ chance of receiving the correct message '0'. We can calculate that sender's $H(X) = H(\frac{8}{24}, \frac{3}{24}, \frac{6}{24}, \frac{7}{24}) = 1.92$. From the formula for conditional probability above we can calculate $H(X|Y) = 0.68$. Hence, the actually transmitted mutual information is equal to $I(X, Y) = 1.92 - 0.68 = 1.24 bits$.

Table 1: The joint probability mass distribution

Sender (↓) & receiver (→) alphabets	0	1	2	3
0	$\frac{7}{24}$	$\frac{1}{24}$	0	0
1	$\frac{1}{24}$	$\frac{2}{24}$	0	0
2	0	0	$\frac{4}{24}$	$\frac{2}{24}$
3	0	0	0	$\frac{7}{24}$

3.4 Efficient coding and the problem of credibility

A natural extension of the framework presented so far, as elaborated by Shannon, is that it is possible to calculate the maximum possible amount of information that can be contained in a message, with a given size of the 'alphabet'. This maximum entropy of a message is achieved when the message coding is perfect, and Shannon found that this is the case when all the symbols in the 'alphabet' or messages to select from are exactly equiprobable, as already mentioned.

In computer science, the problem of efficient coding – based on the equalization of probabilities of the selected codes – presents one of the most fundamental problems, as efficient coding lowers the storage and processing requirements for computers. In human language, achieving efficient coding of this kind is probably never a real target. All languages are

highly patterned systems, with clearly discernible structures. In English, for example, the consonant 't' is much more likely to be followed by 'h' than by 'k'; vowel 'e' is many times more frequent in the language than 'z'; sentences are likely to contain verbs; etc. Human languages are full of redundancies of this kind, which however does not seem to present much of a problem (Fiske, 2002, pp. 10-12). In fact, the 'redundancies' – i.e. the regularities and statistical patterns in the language – increase the chances that communication is successful even in the presence of noise, as we can often infer the content of a message even if a part of the communication has been corrupted. As a result, in practice the possible optimization of coding (i.e. for given alphabet size, message length, and for given noise sources) of human language will often be rather minor and possibly politically un-interesting.

However, this apparatus based on the probability distributions of the messages a sender selects from enables us to capture the politically most salient problem of communication *credibility*. The notion of information transmission is based on a process whereby the state of the receiver changes in response to a message sent by the sender. In our case where we are concerned with the social and political, rather than technical aspects of communication, information is said to be transmitted when the state of mind of the receiving actor is changed based on the information provided, i.e. when the receiver's beliefs are updated. When, however, the receiver does not consider the sender's messages credible, no belief updating process is taking place even if a message has been sent and received.

On the technical level, we can understand the situation of the lack of the sender's credibility as one where the receiver considers all the sender's messages as cheap talk. In this case, he or she does not distinguish between the meanings of the various messages that the sender may choose to send; he or she expects with certainty that whatever message is received it does not carry any meaning based on which his or her beliefs should be updated. Hence any message m received falls into a large uniform set of possible messages, where the probability that a message from this set is selected by the sender approximates $p_m = 1$. In the extreme case where in the receivers perception $p_m = 1$ the structural noise induced by the absence of

the sender's credibility results in that no information at all is transmitted.

Having said that, the senders may have means with which to increase the credibility of their messages, in particular through costly signaling (e.g. Fearon, 1994). They may choose to attach to the messages certain features that would make it costly for them later on if it turned out they were incorrect or not meant seriously. On the technical level, this means that there is a positive probability that the sender sends its core message combined with another message attached to it that carries the costs to him or her (typically in terms of audience costs). In this case, the core message becomes clearly distinct from the cheap talk message, and of course receiving it may be informative, because it is credible.

All these features are best captured by the appropriate changes in the transition matrices capturing the joint distributions of the probabilities of the different messages, as perceived by the sender on the one hand and the receiver on the other hand. In sum, the transition matrix embodies all the features of the communication relevant for the estimate of its information content. It lists all the possible messages from which the sender selects and which the receiver may receive. It outlines the probabilities of these individual messages, as perceived by the sender and by the receiver. These probabilities are adjusted based on the sources of noise – engineering, semantic, and structural – that may hinder the communication. The amount of information contained in the message, or more precisely the average amount of information one can expect to receive when a message choice is revealed, can then be easily calculated from the matrix.

4 Operationalizing information measurement: trade policy reviews in the WTO

In this section, I illustrate the use of the information performance estimation framework outlined above on the case of the WTO Trade Policy Review Mechanism. The following section will then use the approach to provide innovative substantive findings regarding the Mechanism's functioning and role within the WTO.

4.1 Case and data description

The data base for the two empirical sections of the article consists of the written records of all the 322 Trade Policy Reviews (TPRs) that took place within the TPRM between its foundation in 1995 and the end of 2014, i.e. over the time span of 20 years. The TPRM forms the core of the monitoring pillar of the WTO, together with rule-making and dispute-settlement representing one of its three core functions. Within the Mechanism, every WTO member is supposed to undergo a TPR in regular periods of 2, 4, or 6 years, depending on its trade volume. In the review, the WTO membership receives a long report prepared by the WTO secretariat describing the reviewed state's trade policy and various relevant aspects of other trade-related policies. In addition, the reviewed state prepares its own report as well. Evaluating the information from these two reports as well as possibly from other sources, the WTO members review the particular state's trade policies (Ghosh, 2010; Collins-Williams & Wolfe, 2010; Laird & Valdés, 2012; Karlas & Parízek, 2016).

The results of the reviews do not have any direct legal consequences, so technically speaking the reviews are not meant to detect non-compliance with the states' legal obligations. However, the reviews serve as a platform where states can voice their opinions on their peer's behaviour within the regime and on its conformity with its norms and principles (cf. Conzelmann, 2013). In other words, the reviews are primarily and information and transparency

systems, but they clearly contain also a salient element of evaluation and judgment, if in political rather than in legal terms.

Within the TPRs, the reviewing WTO members provide their reviewing input in two forms. First, they may pose to the reviewed state advance written questions. These are often of quite technical nature, and the records of the questions and answers are typically dozens and often hundreds pages long, containing tables, figures and technical data. These written questions can thus be seen primarily as information collection and transparency measures. Second, the states may chose to participate in the TPRs by delivering an oral declaration during the actual TRM meeting, taking place over two days in Geneva. These declarations typically contain much more evaluative statements and are also delivered by more states than questions are asked. In this sense, these declarations tend to present the more politically driven component of the TPRs. In the empirical analysis provided below, I consider the politically more loaded declarations only.

In each TPR, a WTO member makes a decision on three aspects of its participation in the review. First, whether to take part at all, by posing written questions or by delivering a declaration. Second, how long should its input be, i.e. how much it should communicate in quantitative terms. And finally, third, what content it should communicate, especially how positively or negatively it should evaluate the reviewed state's trade policies. The empirical analysis considers all these three aspects of communication within the Mechanism, in order to illustrate the various aspects of the information approach outlined above and how it is operationalized in empirical research.

4.2 Information contained in participation

Let us now move to the measurement of information, as supplied to the Mechanism by the individual WTO members, in the year 2014, the most recent in the dataset. In this subsection I start with the information states communicate by the very act of their participation, i.e.

by the fact that they decide to take part in the review of a particular state. In principle, such a decision can be seen as a message revealing that the reviewing state acares about the reviewed state's trade policy. In table 2, I depict the 21 reviews that took place in 2014 in rows and the participation in these reviews by selected three WTO members – India, Nicaragua, and the United States – in columns.

Table 2: Vectors of participation and declaration length with entropies calculated: USA, IND, NIC

Reviewed	Prt. IND	Prt. NIC	Prt. USA	Dcl. length IND	Dcl. NIC	Dcl. USA
ATG	0	0	1	0	0	3
BHR	1	0	1	3	0	3
CHN	1	0	1	1	0	3
DJI	1	0	1	1	0	3
DMA	0	0	1	0	0	3
GHA	1	0	1	2	0	3
GRD	0	0	1	0	0	3
HKG	1	0	1	2	0	3
KNA	0	0	1	0	0	3
LCA	0	0	1	0	0	3
MMR	1	0	1	2	0	3
MNG	1	0	1	2	0	3
MUS	1	0	1	2	0	3
MYS	1	0	1	2	0	3
OMN	1	0	1	3	0	3
PAN	0	0	1	0	0	3
QAT	1	0	1	2	0	2
TON	1	0	1	2	0	3
TWN	1	1	1	1	2	3
USA	1	0		3	0	
VCT	0	0	1	0	0	3
Entropy	0.92	0.28	0	1.86	0.28	0.29

Let us start the discussion with India, which in 2014 participated in the TPRs of 14 out

of the 21 members, i.e. in 67% of cases. The amount of information carried by its act of participation in TPRs in 2014 is calculated as the entropy of the vector of its participation values (the leftmost column in the table). The size of the 'alphabet' is equal to two, i.e. the reviewer either participates (1) or not (0). The probabilities of each of the two signals are given by their frequencies, i.e. 0.33 for zeros and 0.67 for ones. Hence, the entropy of India's vector of participation is

$$H_{IND2014} = -\sum_{i=[0,1]} p_i log(p_i) = -(0.33log(0.33)) + (0.67log(0.67))) \approx 0.92bits. \quad (4)$$

This means that on average, the decision of India to participate in any given TPR in 2014 carried for the reviewed state approximately 0.92 bits of information, as summarized at the bottom of the table. Note that while the notion of 'bits' may carry strong computer science connotations, it is a perfectly general unit of information, as defined in general information theory. If India participated exactly in one half of the opportunities (in the hypothetical 10.5 cases out of 21), the uncertainty of the reviewed states as to whether to expect India to take part in their review would be maximal, and getting to know its decision would convey 1 bit of information. This can be nicely contrasted with the information carried by participation by the United States. The USA have been themselves reviewed in 2014, and hence have only had a chance to take part in TPRM as a reviewer 20 times. As captured in table 2, they participated in all these 20 opportunities. Hence, the information content of their acts of participation in the year 2014, was

$$H_{USA2014} = -\sum_{i=[0,1]} p_i log(p_i) = -(0log(0)) + (1log(1))) = 0bits.^{3} \quad (5)$$

Hence, even though, or rather precisely because the USA participated always, the act

[3]Note that by convention log(0) is not taken to invalidate the calculation of entropy, as its component is anyway not consider in the calculation as it is multiplied by 0.

of its participation carried for the reviewed state no information whatsoever. It was, quite simply, obvious that the USA would participate in the next review to come, hence the reviewed state faced no uncertainty in this regard. Finally, consider the case of Nicaragua. In 2014, Nicaragua participated in only one of the TPRs out of 21, hence the information content of its participation is

$$H_{NIC2014} = -\sum_{i=[0,1]} p_i log(p_i) = -(0.05log(0.05)) + (0.95log(0.95))) \approx 0.28bits. \quad (6)$$

On average, one would have *a priori* a high confidence in that Nicaragua is not going to participate in a next TPR in 2014 and, most of the times, this expectation would prove correct. Hence, the reviewed state would not receive much unexpected information, its uncertainty would be reduced only very little. Overall, the information content carried by the act of participation or non-participation is the highest for the states that select exactly half of their peers for participation, maximizing the *a priori* uncertainty on their part. Those participating (almost) always or (almost) never do not reveal to their peers much (or any) new information.

In figure 1, I illustrate this general feature of the information content of states' participation on the data for the full WTO membership, again for the 21 TPRs in 2014. On the horizontal axis I depict the member participation rate, i.e. the number of times a member participated divided by 20 or 21, depending on whether the state itself was reviewed. On the vertical axis the entropy corresponding to the given state's participation vector is depicted. Although jitter is added to the member labels for readability purposes, the actual data points form a perfect functional relationship, reflecting the general functional relationship between event (message) probabilities and their corresponding entropies (Shannon & Weaver, 1963, p. 50, Cover & Thomas, 2006, p. 16).

The analysis so far works with a binary message variable, where the state can only select from two signals it sends – participation in the given review ($m = 1$), or absence ($m = 0$). The

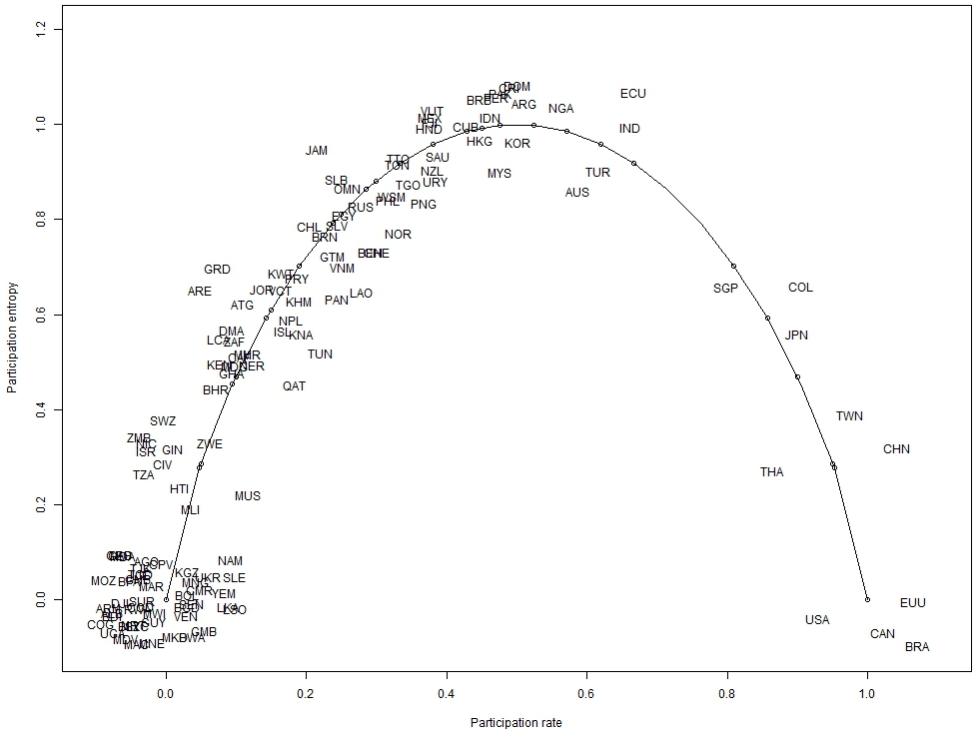


Figure 1: Entropy versus participation rate: TPRM 2014

framework can be extended to alternative measures of participation where we measure states declarations' length. In such a case, it is nevertheless meaningful to quantize the otherwise essentially continuous variables for the length of text (in characters) into some small set of reasonably distinct categories. In other words, the reviewed states are very unlikely to distinguish whether a declaration of their WTO peer contained, say, 2000 characters or 2050 characters declarations. Instead, they may be able to distinguish between declarations that are short, medium, long, and those that have not take place (i.e. length 0). In that case, the alphabet of possible messages would contain four elements, $M = \{0, 1, 2, 3\}$. The *a priori* probabilities of the individual messages would be most easily estimated as the categories' relative frequencies.

For example, we have recoded the declarations' length into four categories, with lengths 1) below 100 characters (category 0), 2) between 100 and 2000 characters (1), 3) between 2000 and 4000 characters (2), and 4) above 4000 characters (3).[4]For illustration, the last three columns in table 2 show the vecotrs of declaration lengths, thus re-coded, and their corresponding entropies, again for India, Nicaragua, and the United States. The information content sent by Nicaragua is exactly equal to that sent by its single participation, which is given by that again its vector of declarations' lengths contains only one non-zero value (occurring with the probability $\frac{1}{21}$). The information sent by the USA is positive here, because in the case of the review of Qatar the USA have only made a medium length declaration, while in all other cases they delivered a long one. Finally, the information content sent by India, with regard to its declarations length, is high, 1.86 bits. Seven times it abstained, 3 times it delivered a short declaration, 8 times a medium one, and 3 times a long one.

[4]Some states delivered in 2014 a joint declaration, and the text length is divided by the number of the members of the groups of such states. A threshold of mere 100 characters is used to cut off the shortest such 'pseudo-declarations'.

4.3 Information contained in declarations content

The information about whether or how much a particular WTO member cares about trade policies of the reviewed state is of course just one type of information that is communicated within the TPRM. Equally important, if not more, is the content of the reviews. In illustrating the information performance framework developed here, I will focus on probably the single most salient aspect of the content of TPRs, namely on the overall degree to which the participating states consider the trade policies to be broadly in line with the spirit and fundamental norms and principles of the trade regime. In other words, do its peers perceive the reviewed member's policies positively or negatively?

Perhaps the most intuitive way to assess this crucial content of the TPRs would be to conduct a large-scale qualitative content analysis of the declarations records (see Karlas & Parízek, 2016). However, such a procedure can only be applied to a limited time-span or a limited set of WTO members, due to the enormous amount of empirical material. An alternative approach I turn to is to run an automated content analysis with a vocabulary of terms capturing positive and negative evaluation words. Based on an extensive reading of the declarations records I have identified the following five keywords as indicators of positive evaluation of the reviewed state's trade policy: ['commend', 'praise', 'good', 'excellent', 'robust']. Similarly, the following six keywords have been identified as indicators of negative evaluation: ['condemn', 'bad', 'worrying', 'trouble', 'concerned', 'criticize']. The choice of the vocabulary is somewhat arbitrary, of course, and this is a matter I return to later on.

In terms of the technique employed for the automated content analysis, I use the nltk (Natural Language Toolkit) package of the Python programming language. The package containts a number of built-in functions for natural language processing and a range of relevant vocabularies. In particular, I have applied the stemming procedure based on the so-called Porter stemmer.[5]The procedure ensures that all forms of the given word, including those with various morphological and inflexional endings, are considered in the keywords

search. In the procedure the Python script runs through all the submitted text, identifies the (stems of the) words indicated in the vocabulary, and counts their occurrences within the individual declarations. As previously, I 'quantize' the variables capturing the numbers of identified keywords. That is, I recode the numbers of such positive or negative keywords into a smaller set of meaningfully distinct categories, i.e. to whether the number of positive (negative) words is small (1), medium (2), or high (3), or whether they are altogether absent (0).

The vectors of the counts of positive and negative words made by a specific reviewer in all the TPRs in the given year form the basis for the calculation of the member's evaluations' information content. The more variety there is in the frequencies of the positive and negative evaluative words used by a state across the reviews, the more information its declarations carry. In contrast, high uniformity of the words used suggests low information content, as the evaluative pattern of the given declaration is highly predictable.

In figure 2, I depict the curvilinear relationship between the number of evaluative words identified, against the information content of these words. Clearly, for a large range of the numbers of evaluative words the more such words, the higher their overall information content. This is perfectly intuitive, as states need to communicate their evaluations for there to be any content in the first place. However, beyond certain threshold the increase in the number of evaluative words is not any more associated with increased content. The pattern of evaluation becomes increasingly uniform and no additional information is provided. This is well illustrated with the cases of the European Union and especially the United States.

The picture is even more pronounced when we consider only the positive evaluative statements, as captured in figure 3. There the reverse trend of decreasing information content for declarations with many positive statements is clearly discernible, especially in the cases of the USA, the EU, and China. Quite simply, at some point their positive evaluations become predictable and do not carry new information.

[5]For information about the stemmer nltk.PorterStemmer, see https://tartarus.org/martin/PorterStemmer/.

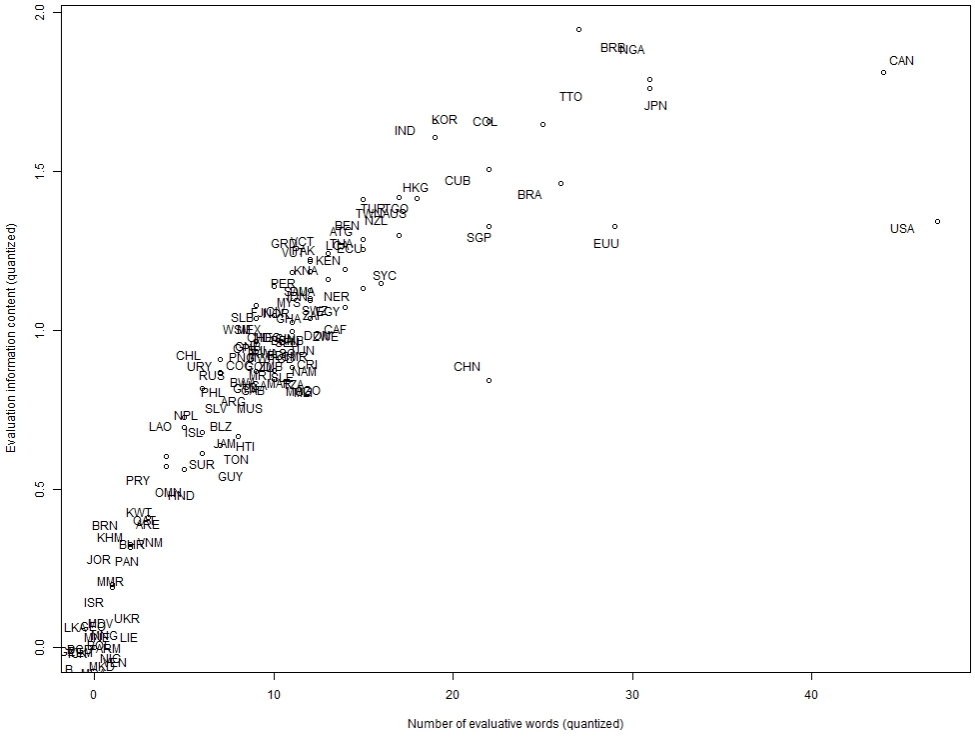


Figure 2: Evaluation information content (entropy) versus number of evaluative words: TPRM 2014

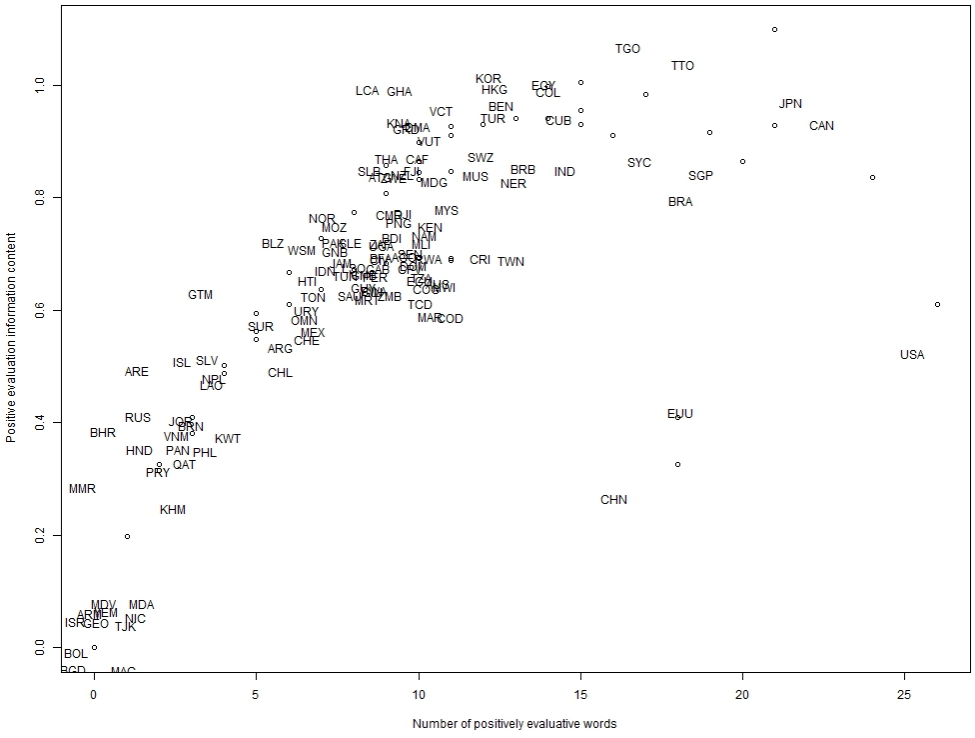


Figure 3: Positive evaluation information content (entropy) versus number of positive evaluative words: TPRM 2014

4.4 Differences in probabilities perceived by sender and the receiver

Communication is an inter-personal endeavour and, naturally, the persons may differ in how they perceive what is being communicated. For one, they may differ in how many different messages they are able to distinguish. A receiver may be unable to trace certain nuances in the communicated message the sender wanted to insert, or may see two different messages there where the sender meant to make no distinction. In the previous calculations, we have used an adjustment whereby a quasi-continuous variable of declarations length or of the number of evaluative signals has been recoded into a small set of more distinct categories of no (0), small/short (1), medium (2), and large/long (3) declarations or numbers of evaluative statements. Some actors may find it meaningful to apply a more fine-grained measure (e.g. 0-10), others may be only considering simple binary distinctions (0/1).

Second, the sender and the receiver may differ in their estimates of the *a priori* probabilities of the various messages. In the estimates above I used the simplest possible model for the probabilities, the frequencies of the various messages, over the given time period. However, the actors may naturally differ in a number of factors that come into the estimate, such as the reference period, the cases considered in the estimation, or e.g. the discounting of the more distant cases. In general, the actors may employ all kinds of estimation techniques, for instance Bayesian updating, or extremely simplifying rules of thumb, such as that all developed countries behave the same, all rising powers behave the same, and all developing countries behave the same.

Let us illustrate this with the example of data from the Indian case, considering the categories of declarations' lengths. As I already reported, in 2014 India delivered 3 short, 8 medium, and 3 long declarations, and 7 times it abstained. Hence, its vector of declaration length probabilities is $[\frac{7}{21}, \frac{3}{21}, \frac{8}{21}, \frac{3}{21}] = [0.33, 0.14, 0.38, 0.14]$. The entropy of this vector is equal to $H_{IND2014} = 1.86$ bits. Suppose we want to estimate the amount of information carried by the India's choice of declaration lengths, but for a state that does not distinguish

Table 3: Varying alphabets as seen by the sender and the receiver; the joint probability mass distribution

Sender (↓) & receiver (→) alphabets	0	1&2	2
0	0.33	0	0
1	0	0.14	0
2	0	0.38	0
3	0	0	0.14
$\sum$	0.33	0.52	0.14

between short and medium declarations length. In table 3 I depict such a situation. In this case, the amount of information the receiver can abstract form its knowledge of India's behaviour in 2014 is $H'_{IND2014} = 1.42$. Following the definition of mutual information introduced above, we can calculate that $H''_{IND2014} = 0.53 + 0.13 + 0.36 + 0.40 = 1.42$. Naturally, no more information could be transmitted than the receiver was able to receive.

4.5 Noise

The previous discussion of different perceptions of the communication by the two sides is related to the problem of communication noise. Both these issues have to do with factors that lead to that the message received by the receiver is not identical to the message sent by the sender. In the case of varying sizes of alphabet and probability distributions estimates the source of this divergence lied in the properties of the communication participants. In the case of noise, the divergence is driven by factors pertinent to the communication environment, or the structure within which it takes place.

As discussed previously, I identify three types of noise that may spoil communication: engineering noise, semantic noise, and structural noise. Let us estimate the amount of each of them in turn, again for all the TPRs in the year 2014. With regard to the engineering noise, I do not expect it to be a salient feature of communication in the TPRM, at least not when the communication as recorder in the questions records and meetings minutes. However, one

way to estimate the amount of such error is to consider the problems in document availability in the WTO database. During the data collection, it was found that the documents from one of the reviews from year 2013, that of Macedonia, are missing. In the years 1995–2014, altogether 323 times a WTO member has undergone a TPR. This leads me to a rough estimate of engineering noise at $\frac{1}{323} \approx 0.003$. Technically, this means that a signal sent by the reviewing state has a 0.3% chance of changing its value – in the case of binary signals from 0 to 1 or vice-versa, in other cases from one message to another, e.g from 2 to 3 or 0.

Semantic noise is difficult to estimate because it pertains to the differences in meanings actors ascribe to the same words and expression, or messages. One way to provide an estimate of such noise in our automated content analysis of evaluative statements within the TPRs is to vary the exact terms searched for, based on different vocabularies different speakers would choose to represent positive and negative evaluation. Based on suggestions from several colleagues, I have adjusted the vocabularies used for positive evaluations identification by replacing the keyword 'robust' with 'appreciate', leading to the list ['commend', 'praise', 'good', 'excellent', 'appreciate']. The negative list has been suggested to remain the same. I have re-run the keywords search with this small adjustment. What results from this change of the vocabulary understood to denote positive evaluation used is a relatively minor adjustment in the number of the evaluative statements thus detected. While in the original vocabulary altogether 926 positively evaluative statements have been identified, with the adjusted vocabulary the number increased to 941, by 1.6%.

Finally, one illustrative way to estimate structural noise may be to consider moving the thresholds for the measurement of positive evaluations in the states' declarations. Based on the extensive reading of the declarations, one can make the claim that there is a norm or habit of making at least some positive statements, often very vague, mostly as a matter of politeness (cf. Karlas & Parízek, 2016). In other words, one can easily claim that a certain amount of praise raised in any given TPR is nothing but cheap talk, message carrying no actual evaluative information, but instead establishing an obligatory diplomatic language

framework. Technically, a natural way to take this structural factor into account is by subtracting one from the recorded number of positive evaluative statements. In other words, we can consider in each declaration one positive statement as a background structural noise – nothing but cheap talk – and re-estimate the amount of information carried over the communication channel, taking this into account.

On the technical level, the way to incorporate noise into the calculation of transmitted information is, again, by depicting the joint distribution of the available signals as perceived by the sender and by the receiver. The noise will be represented by positive probability mass off the main diagonal, as in the example in table 1 earlier in the text.

5 Information flows in the Trade Policy Review Mechanism 1995–2014

In the previous section, I have discussed how information flows within the TPRM can be assessed, at least in a very rough sense, considering information communicated through the act of states' participation in the individual TPRs and the evaluative information, as captured through a keyword search. I have used the data from all the 21 reviews that took place in 2014. In this section, I extend the time covered to the entire period 1995 – 2014. This will enable us to capture critical information flows developments in TPRM over the course of the WTO's existence. However, I also show how these developments and patterns relate to the broader international environment and to the changing distribution of power and interests in the global trade regime.

Let us recall the brief discussion from the Introduction where it was argued that when preference conflicts are strong among international institutions' member states, the best the institutions can achieve, in promoting cooperation, is the improved provision of information. This is the role and function of international institutions, as envisioned by early cooperation and regime theorists in 1980s (Axelrod & Keohane, 1985; Keohane, 1984). This function can be contrasted with formal rule-making and rule-enforcement functions, based on political authority, as ascribed to political institutions in domestic political systems, but sometimes also to international institutions. In this view of international politics, institutions do not work by providing strict enforceable rules that need to be complied with. Such rules hardly ever exist and if they do, they will typically reflect the lowest common denominator of the states' interests (Downs *et al.*, 1996) or the interests of the dominant, hegemonic power (Kindleberger, 1986). Rather, it is based on the states' shared understanding of a common interest in cooperation, but also in the acknowledgment of all the limitations imposed on cooperation by the anarchical environment. Instead of formal rules and compliance, it focuses on the communication among the actors, reputation building, reasons for (possible) non-

compliance, and the building up of shared understandings.

In the WTO, this seemingly softer function of international institutions has its manifestation primarily in the TPRM pillar. While rule-making (the Doha negotiations) and adjudication (dispute settlement) do mostly correspond to legalization and hard cooperation, the TPRM is primarily based on a peer-reviewing mechanism and exchange of information. This is most strongly manifest in the strict principle according to which information revealed during the TPRs cannot have any direct legal repercussions (Marakesh Agreement, Annex 3, art. A, i)). Quite intuitively, we would expect that when the conflict of interests of the WTO members increases, and when this conflict cannot be over-ruled by a single dominant power able to impose its will on others, the relative importance of this kind of cooperation based on peer-review mechanisms can grow more important, relative to the legalized cooperation schemes, as these tend to be much harder to negotiate (e.g. Fearon, 1998).

The best way to assess the validity of this reasoning is to see if there are any discernible trends in the use of the TPRM framework for cooperation. In the situation where the rule-making pillar – primarily in the form of the Doha negotiations – has been stuck for 15 years, with mostly symbolic progress in the form of the Bali and Nairobi deals, do we observe an increase in the information flows within the TPRM?

Using the empirical data just introduced, we can observe that there is a massive upwards trend in the amount of information in the TPRM. Let us focus first on participation and the information the acts of participation carry, as discussed previously. In figure 4, I depict the simple number of participations in TPRs in the given years (the full line), i.e. the sum of the numbers of declarations delivered across the WTO membership. Over the period, the yearly number of declarations rose form around 100 to around 600, with a steady trend. In addition, the dashed line shows the sum of the entropies of the vectors of participation of the individual WTO members, i.e. the analogues of the vectors depicted earlier in the text in table 2. The gradual increase in the amount of information contained in the acts of participation is also clearly discernible. Interestingly, until around 2003 the rise in participation is not matched

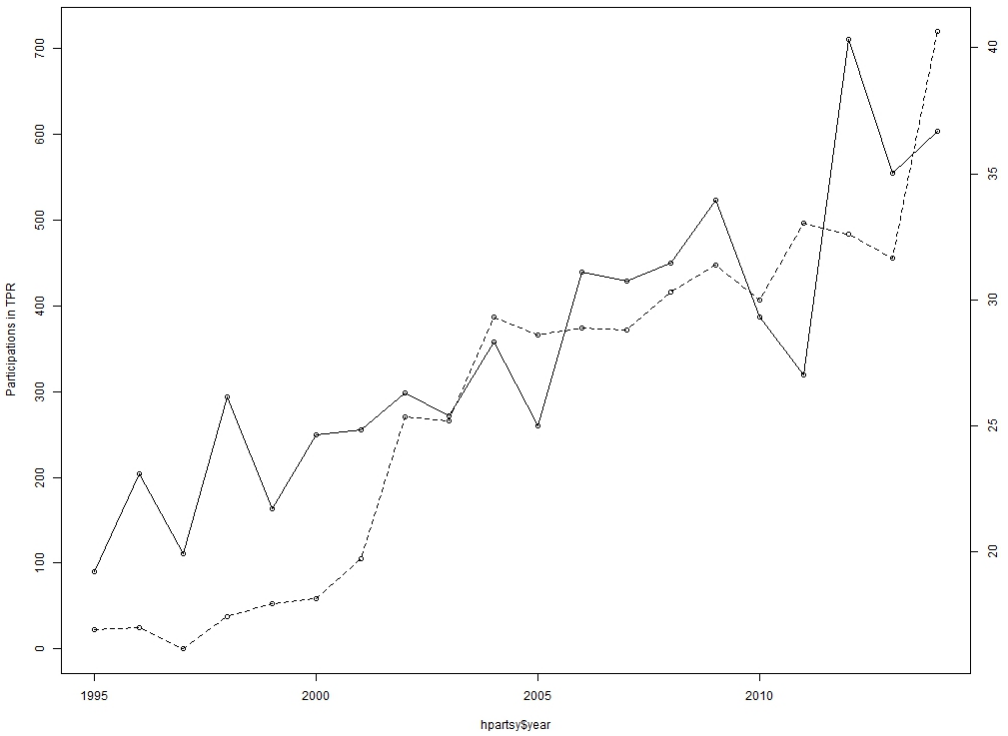


Figure 4: Participation and participation information content: 1995–2014

by an increase in the information contained in participation. Since around 2003, this changes and the two variables rise in parallel.

In figure 5, I turn to the information contained in the evaluations in the declarations. Based on the keyword search discussed previously, I estimate the amount of positive and negative evaluations in the reviews. The full black line depicts the number of positive evaluative statements, while the somewhat lower situated dashed line the number of negative evaluative statements. Since over time there is an increase in the participation rate, and hence the crude numbers of keywords searched could be attributable to this factor, the red full rising line also depicts the number of evaluative statements (positive and negative combined) *per* one declaration delivered. Even controlling for participation, the increase is remarkable, from an average of around 1.5 to 4.

Finally, let us consider the information content of these evaluative statements, as de-

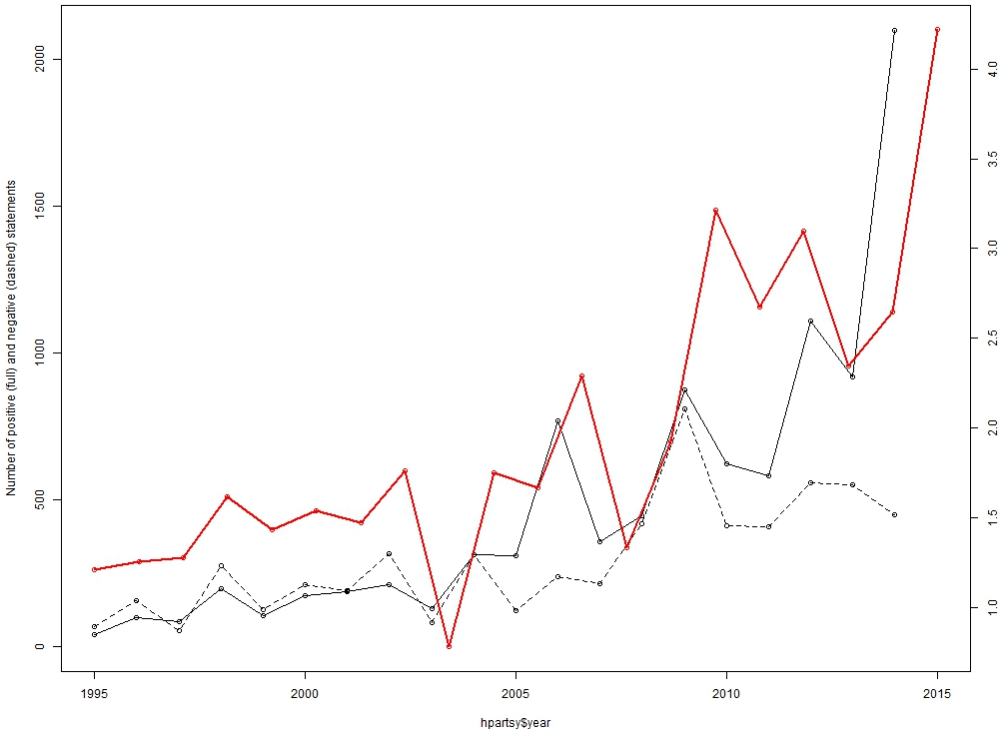


Figure 5: Positive and negative evaluations and their information content: 1995–2014

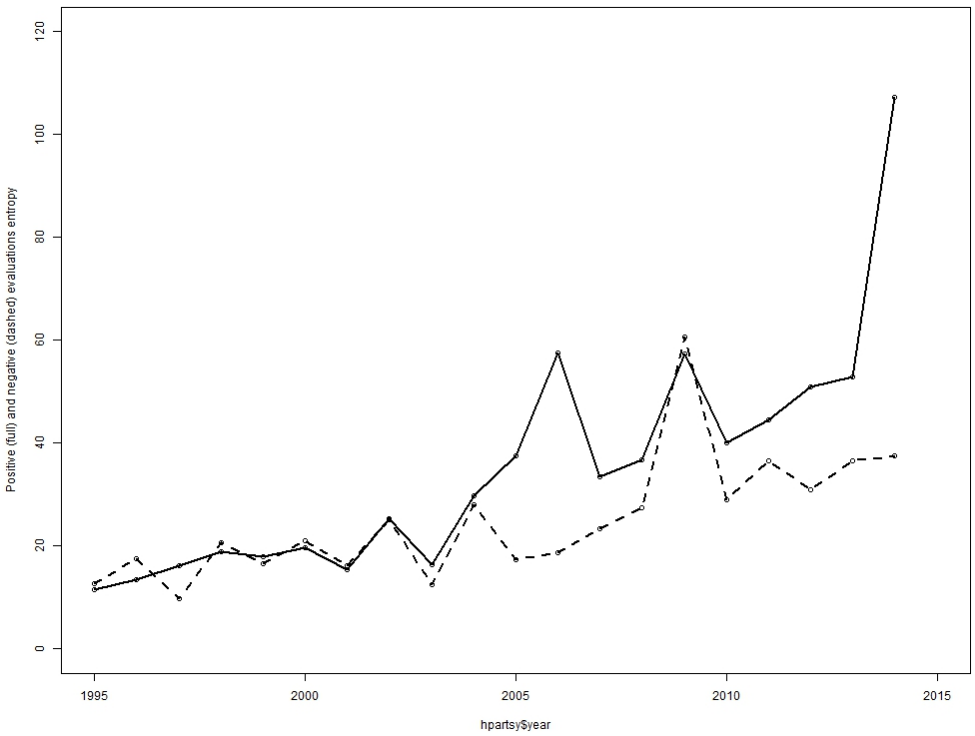


Figure 6: Positive and negative evaluations information content: 1995–2014

picted in figure 6. The two lines depict the information contained in the numbers of positive (full) and negative (dashed) evaluative words. As previously, the information content is calculated as the sum of the entropies across the WTO members, where the individual entropies are calculated form the vectors of the numbers of evaluative words identified with the keywords search. While an increase is observable in both positive and negative evaluations, in the positive ones it has been very steep in the most recent period. All this points to a rather prominent upwards trend in the information flows within the TPRM. This seems to correspond with the reasoning outlined above, with regard to the rising prominence of the softer cooperation mode, as opposed to the hard legalized modes of rule-making and dispute settlement.

To further assess the validity of this reasoning, I present three more figures that depict somewhat more nuanced or specific measures of information content within the TPRM. First

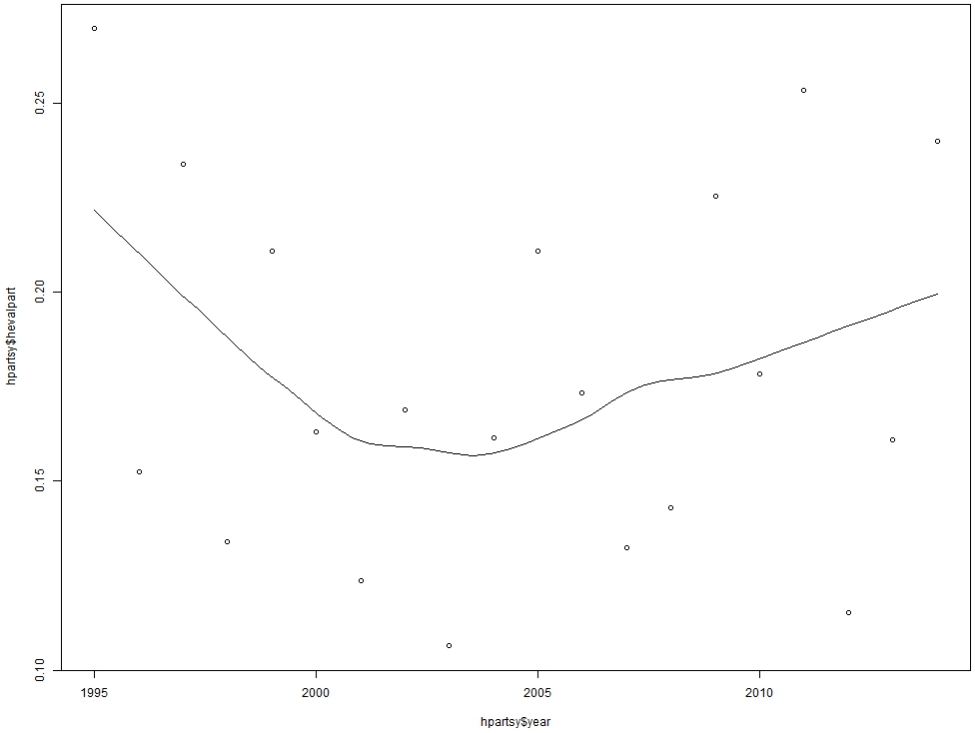


Figure 7: Evaluative information: 1995 – 2014

of all, I have already mentioned that we see a dramatic increase in the members' participation in the TPRs, over the years. Perhaps the increase in the information could be attributable solely to the increase participation. However, it turns out this is not the case. In figure 7, the amount of evaluative information – positive and negative combined – is depicted, but not in absolute values, as in figure 6, but instead again *per* declaration delivered. Hence, it shows the average entropy calculated based on the numbers of positive and negative evaluations, per one declaration. Instead of a steady upwards trend presented previously, we see a clear U-shaped pattern, with a markable decline in between 1995 and around 2003, followed by an equally notable rise from around 2003 onwards. Although there is a lot of variation along the locally weighted regression curve, the overall pattern is rather clearly present in the data.

Interestingly enough, the very same development can be seen in the perhaps best measure of information contained in TPRs presented in figure 8. For this chart, I have calculated for

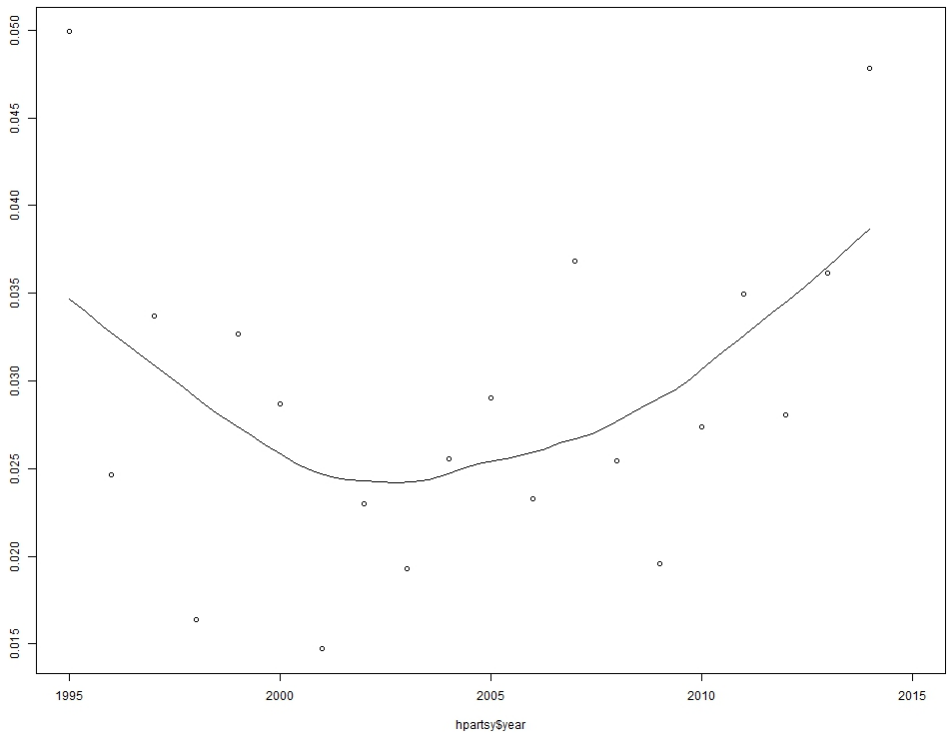


Figure 8: Pos/(pos+neg): 1995–2014

each declaration the ratio of positive statements to the sum of both negative and positive statements. Hence, this ratio approaches zero when the reviewer's evaluation of the reviewed state is purely negative, and 1 when it is purely positive. For each reviewing state in each of the years, the value of entropy then reflects the variation across these evaluations. The more variation there is, the more evaluative information the given WTO member's carry, as it means that the state is able to make clear distinctions among its peers. Once again, I depict the average amount of such information, per one declaration delivered. Analogously to figure 7, we observe a clear U-shaped development, with a steady decline in information content until around 2003, followed by a pronounced upwards trend ever since.

These observations seem to be fully in line with the theoretical reasoning introduced above, arguing that with the problems of the rule-making pillar we should see a shift of the cooperation efforts to the 'softer', i.e. non-legalized modes of cooperation, based on reciprocal

information exchange. I believe there is one more piece of evidence that supports the validity of this reasoning, concerning the position of investment within the WTO. Investment (or trade and investment) formed one of the four so-called Singapore issues, that started to be negotiated in Singapore in 1996 but that were dropped, upon the insistence of India and other emerging markets, at the Cancun ministerial conference in 2003 (e.g. Woolcock, 2003; Narlikar & Tussie, 2004). In some sense, the Singapore issues represented the final frontier of trade liberalization at the time, cutting deep into the domestic arrangements of the WTO members.

To capture the presence of the investment issue in the TPRM, I have replicated the keywords search procedure from the analysis of evaluations, but this time with a single keyword ['invest']. Based on the numbers of the terms' occurrences, I have calculated the information content of the TPRs with regard to investment. In figure 9, I depict the aggregate values, for the amount of investment-related information in the individual years. What we see is stability or a minor decline between 1995 and around 2005, followed by a significant rise in the period afterwards. Even though the issue of investment has been dropped from the Doha agenda, or perhaps precisely *because* of it, it appears much stronger in the less formalized TPRM pillar, in the period following the (first) major breakdown of the Dohan negotiations at the Cancun Ministerial. It seems that when it become impossible to seek legalized regulation of the matters, the agenda may have shifted to the non-legalized, information exchange based pillar of the TPRM.

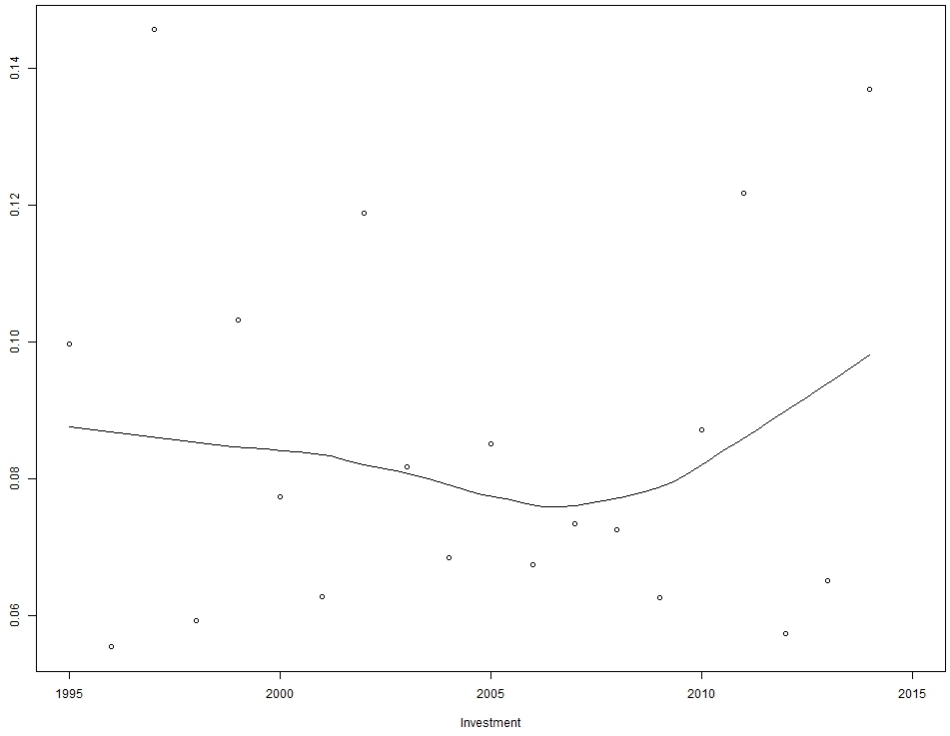


Figure 9: Investment discussion in TPRs

6 Conclusions

International cooperation is based on reputation-building and on the exchange of information among the cooperating parties. In the absence of wide ranging transfers of political authority, combined with enforcement capacities, to international institutions, the only option for cooperation to be sustained is decentralized enforcement. In the World Trade Organization, as a member-driven organization, this is true even more than in many other major global bodies (cf. Elsig, 2010). When the views of the key regime stakeholders are aligned, formal rule-making and legalization can proceed, states' commitments may become stronger and legally enforceable. When the interests diverge, however, creating new rules to reflect the changing reality of the global economy may become tedious. This has clearly become the case in the WTO.

The core purpose of this article is to develop a framework that would enable us to assess how international institutions work under such conditions. In other words, I take the minimalist perspective that what institutions should do is primarily enhanced communication. When state's interests collide, arguably little more can be achieved anyway. The framework is built on a set of insights from the information theory, in particular with regard to the measurement of the information content – or entropy – of political communication. Using the framework, I argue and illustrate, we can estimate the information transmission performance of international institutions.

Using the evidence from the 20 years of the operation of the Trade Policy Review Mechanism, I argue that we observe a major shift towards this non-legalized pillar of the WTO, notable especially in the last around 10-12 years, largely coinciding with the crisis of the rule-making pillar. I put forward the argument, that in the global trade regime we may be observing a major from hard cooperation, based on legalized enforceable rules, to softer cooperation, based on information exchange. Such a mode of cooperation is theoretically as well as historically prior to the more formalized and legalized modes of cooperation we

might have gotten used to in many areas especially after the end of the Cold War. It is possible that when the work of the major global bodies becomes increasingly contested, as a result of the changing balance of key members' power and interests, such shifts to softer cooperation modes based 'merely' on information exchange may become more frequent. In that case, information-oriented frameworks for the assessment of institutions performance, such as the one presented here, should become increasingly relevant.

References

Akerlof, George A. 1970. The Market for Lemons: Quality Uncertainty and the Market Mechanism. *The Quarterly Journal of Economics*, **84**(3), 488–500.

Axelrod, Robert. 1981. The Emergence of Cooperation among Egoists. *The American Political Science Review*, **75**(2), 306–318.

Axelrod, Robert, & Keohane, Robert O. 1985. Achieving Cooperation under Anarchy: Strategies and Institutions. *World Politics*, **38**(1), 226–254.

Böhmelt, Tobias. 2012. A closer look at the information provision rationale: Civil society participation in states' delegations at the UNFCCC. *The Review of International Organizations*, **8**(1), 55–80.

Campbell, David. 1992. *Writing Security: United States Foreign Policy and the Politics of Identity*. Minneapolis: University of Minnesota Press.

Collins-Williams, Terry, & Wolfe, Robert. 2010. Transparency as a trade policy tool: the WTO's cloudy windows. *World Trade Review*, **9**(04), 551–581.

Conzelmann, Thomas. 2013. Peering at the peers: How do peer reviews among states take shape in four international organizations? *Paper presented at the 41st ECPR Joint Sessions of Workshops*.

Cover, Thomas M., & Thomas, Joy A. 2006. *Elements of Information Theory*. 2nd edn. Hoboken, N.J: Wiley-Interscience.

Crawford, Vincent P., & Sobel, Joel. 1982. Strategic Information Transmission. *Econometrica*, **50**(6), 1431–51.

Dai, Xinyuan. 2002. Information Systems in Treaty Regimes. *World Politics*, **54**(4), 405–436.

Der Derian, James, & Shapiro, Michael J. (eds). 1998. *International/Intertextual Relations: Postmodern Readings of World Politics*. 1st edn. Lexington: Lexington Books.

Dijkstra, Hylke. 2015. Shadow bureaucracies and the unilateral control of international secretariats: Insights from UN peacekeeping. *The Review of International Organizations*, **10**(1), 23–41.

Downs, George W., Rocke, David M., & Barsoom, Peter N. 1996. Is the Good News About Compliance Good News About Cooperation? *International Organization*, **50**(3), 379–406.

Elsig, Manfred. 2010. The World Trade Organization at work: Performance in a member-driven milieu. *The Review of International Organizations*, **5**(3), 345–363.

Fearon, James D. 1994. Domestic Political Audiences and the Escalation of International Disputes. *The American Political Science Review*, **88**(3), 577–592.

Fearon, James D. 1995. Rationalist Explanations for War. *International Organization*, **49**(3), 379–414.

Fearon, James D. 1998. Bargaining, Enforcement, and International Cooperation. *International Organization*, **52**(2), 269–305.

Fiske, John. 2002. *Introduction to Communication Studies*. 2nd edn. London: Taylor & Francis.

Ghosh, Arunabha. 2010. Developing countries in the WTO Trade Policy Review Mechanism. *World Trade Review*, **9**(03), 419–455.

Gleick, James. 2012. *The Information: A History, A Theory, A Flood*. New York: Vintage.

Gutner, Tamar, & Thompson, Alexander. 2010. The politics of IO performance: A framework. *The Review of International Organizations*, **5**(July), 227–248.

Hawkins, Darren G., Lake, David A., Nielson, Daniel L., & Tierney, Michael J. (eds). 2006. *Delegation and Agency in International Organizations*. Cambridge: Cambridge University Press.

Helm, Carsten, & Sprinz, Detlef. 2000. Measuring the Effectiveness of International Environmental Regimes. *Journal of Conflict Resolution*, **44**(5), 630 –652.

Ikenberry, G. John. 2011. The Future of the Liberal World Order. *Foreign Affairs*, **90**, 56–62.

Kahler, Miles. 2013. Rising powers and global governance: negotiating change in a resilient status quo. *International Affairs*, **89**(3), 711–729.

Karlas, Jan, & Parízek, Michal. 2016. Aktivita členských států WTO v Mechanismu přezkoumávání obchodní politiky. *Mezinárodní vztahy*, **51**(2), 30–49.

Keohane, Robert O. 1984. *After Hegemony: Cooperation and Discord in the World Political Economy*. Princeton: Princeton University Press.

Kindleberger, Charles P. 1986. *The world in depression, 1929-1939*. Berkeley: University of California Press.

Krasner, Stephen D. 1982. Structural Causes and Regime Consequences: Regimes as Intervening Variables. *International Organization*, **36**(2), 185–205.

Laird, Sam, & Valdés, Raymundo. 2012. The Trade Policy Review Mechanism. *Pages 463–484 of:* Narlikar, Amrita, Daunton, Martin, & Stern, Robert M. (eds), *The Oxford Handbook on The World Trade Organization*. Oxford: Oxford University Press.

Martin, Lisa L. 2006. Distribution, information, and delegation to international organizations: the case of IMF conditionality. *Pages 140–164 of:* Hawkins, Darren G., Lake,

David A., Nielson, Daniel L., & Tierney, Michael J. (eds), *Delegation and Agency in International Organizations*. Political Economy of Institutions and Decisions. Cambridge: Cambridge University Press.

Milner, Helen V. 1997. *Interests, Institutions, and Information: Domestic Politics and International Relations*. Princeton: Princeton University Press.

Mitchell, Ronald B. 1994. Regime Design Matters: Intentional Oil Pollution and Treaty Compliance. *International Organization*, **48**(3), 425–458.

Mitchell, Ronald B. 1998. Sources of Transparency: Information Systems in International Regimes. *International Studies Quarterly*, **42**(1), 109–130.

Morrow, James D. 1994. Modeling the Forms of International Cooperation: Distribution Versus Information. *International Organization*, **48**(3), 387–423.

Morrow, James D. 2001. The Institutional Features of the Prisoners of War Treaties. *International Organization*, **55**(04), 971–991.

Moser, Stefan M., & Chen, Po-Ning. 2012. *A Student's Guide to Coding and Information Theory*. 1 edition edn. Cambridge ; New York: Cambridge University Press.

Narlikar, Amrita. 2013. Negotiating the rise of new powers. *International Affairs*, **89**(3), 561–576.

Narlikar, Amrita, & Tussie, Diana. 2004. The G20 at the Cancun Ministerial: Developing Countries and Their Evolving Coalitions in the WTO. *World Economy*, **27**(7), 947–966.

Parízek, Michal. 2016. Control, soft information, and the politics of international organizations staffing. *The Review of International Organizations*, Apr., 1–25.

Raustiala, Kal, & Slaughter, Anne-Marie. 2002. International Law, International Relations and Compliance. *Pages 538–558 of:* Carlsnaes, Walter E., Risse, Thomas, & Simmons, Beth A. (eds), *Handbook of International Relations*. London: Sage Publications Ltd.

Shannon, Claude E., & Weaver, Warren. 1963. *The Mathematical Theory of Communication*. Urbana: University of Illinois Press.

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*, May.

Stone, James V. 2015. *Information Theory: A Tutorial Introduction*. 1st edn. Sebtel Press.

Tallberg, Jonas, Sommerer, Thomas, Squatrito, Theresa, & Jönsson, Christer. 2014. Explaining the Transnational Design of International Organizations. *International Organization*, **68**(4), 741–774.

Tallberg, Jonas, Sommerer, Thomas, Squatrito, Theresa, & Lundgren, Magnus. 2016. The performance of international organizations: a policy output approach. *Journal of European Public Policy*, **23**(7), 1077–1096.

Thompson, Alexander. 2006. Coercion Through IOs: The Security Council and the Logic of Information Transmission. *International Organization*, **60**(01), 1–34.

Wiener, Norbert. 1948. *Cybernetics : or the Control and Communication in the Animal and the Machine*. Cambridge: The MIT Press.

Woolcock, Stephen. 2003. The Singapore issues in Cancún: A failed negotiation ploy or a litmus test for global governance? *Intereconomics*, **38**(5), 249–255.

Young, Oran R. 2001. Inferences and Indices: Evaluating the Effectiveness of International Environmental Regimes. *Global Environmental Politics*, **1**(1), 99–121.