**Appendix – Supplementary Materials**

**Figure A1. Civic voluntarism model, general incentives model, and their integration**

**General incentives model specifies the motivational factors**

Motivations

*Resources*

*Mobilization*

*Citizen   
Participation*

*Collective   
Incentives*

*Selective   
Incentives*

*Social Norm-derived   
Incentives*

*Group   
Incentives*

*Expressive   
Incentives*

**Civic voluntarism model outlines the major categories of participation antecedents**

In this study, we employ the civic voluntarism model to identify the major classes of participation antecedents (motivations, resources, and mobilization), and the general incentives model to derive the specific motivational factors for our theoretical model

**Table A1. Review of Literature Investigating Both Quantity and Quality of Participation in Online Forums**

|  |  |  |  |  |  |
| --- | --- | --- | --- | --- | --- |
| **Source** | **Research Focus** | **Nature of Online Forums** | **Dependent Variable(s)** | **Research Method** | **Major Findings** |
| [14] | Integrate the social cognitive theory and social capital theory to investigate individuals’ willingness to share knowledge | Online IT-oriented professional forums (for knowledge sharing about programming, databases, and operating systems) | - Quantity of knowledge sharing (perceptual)  - Quality of knowledge sharing (perceptual) | Survey | - Community-related outcome expectations have a significant impact on knowledge sharing in terms of both quantity and quality  - Social interaction ties, reciprocity, and identification increased quantity of knowledge sharing  - Trust has a significant impact on quality of knowledge sharing, but not quantity  - Social interaction ties, norm of reciprocity, and identification may have indirect effects on knowledge quality via trust  - Shared language does not have a significant impact on quantity of knowledge sharing, while shared vision has a negative influence on quantity of knowledge sharing  - Both shared language and shared vision have significant positive influence on quality of knowledge sharing |
| [87] | Employ the critical mass theory to explain individuals’ behavior of contributing reviews online | Online forums for review information sharing (users’ sharing of reviews on books, music, videos and other products sold on the Amazon.com site ) | - Quantity of review contributions  - Quality of review contributions (“helpful” votes received) | Content analysis of top-1000 reviewers’ profile information | - The 1000 most prolific reviewers are extraordinary active (higher volume and quality of reviews contributed)  - Self-oriented motives (utilitarian benefits, self-expression) are positively correlated with quantity of contributions, whereas social-oriented motives (social affiliation) are negatively related to this dependent variable  - Social-oriented motives (reciprocity and altruism) are positively correlated with quality of contributions, whereas self-oriented motives (utilitarian benefits) are negatively related to this dependent variable |
| [116] | Test a model of social capital to investigate why people contribute knowledge to others in online forums | Online communities of practice (sponsored by a national legal association for its members to exchange legal knowledge) | - Volume of knowledge contribution (count)  - Helpfulness of knowledge contribution (content analysis) | Survey and content analysis | - Volume of knowledge contribution is positively affected by desire for reputation, network centrality, and tenure in field; while negatively affected by reciprocity  - Helpfulness of knowledge contribution is positively affected by desire for reputation, enjoy helping (weak relationship), centrality in social network; while negatively affected by commitment or perceived obligation to the forum |
| [122] | Investigate the role of commitment, reciprocity, informational value, sportsmanship, and online interaction propensity on quality and quantity of knowledge contribution | Firm-hosted technical support forums (for like-minded IT enthusiasts to interact and engage in peer-to-peer technical support and knowledge sharing on computer hardware and software issues) | - Quantity of knowledge contribution (count)  - Quality of knowledge contribution (based on points received) | Survey | - A customer’s online interaction propensity, commitment to the community, and the informational value s/he perceives in the community are the strongest drivers of knowledge contribution, both in terms of quantity and quality  - Commitment to the host firm does not impact the quantity of knowledge contribution, and negatively affects the quality of contribution  - Online interaction propensity strengthens the relationship between commitment to the community and both quantity and quality of knowledge contribution  - Reciprocity acts as a moderator and strengthens the positive direct effect of online interaction propensity on the quantity of knowledge contribution |

**Supplementary Information - Explanation of the Coding Scheme**

Previous literature has attempted to measure the ideal state of participation in an online policy deliberation forum, which resulted in various criteria being proposed for this purpose. Based on a comprehensive review of the literature, Janssen and Kies [46] summarized the previously proposed criteria as: reciprocity, justification, reflexibility, ideal role taking, sincerity, inclusion, discursive equality, and autonomy. Subsequently, we updated their literature review and summarized the resulting criteria (see Table A2 below). Our assessment of these criteria indicates that *justification* is the most relevant for our purpose, i.e., for evaluating individuals’ quality of participation in OPDFs (see the Remark column of Table A2 for the reasoning).

**Table A2. Summary of Criteria for Assessing Ideal Participation in OPDFs**

|  |  |  |
| --- | --- | --- |
| **Criterion** | **Conceptualization** | **Remark** |
| Reciprocity [R2, R5, 34, 47] | The extent to which a conversation is a real “discussion”, such that a high degree of two-way exchanges of perspectives is present | More appropriate as a collective-level measure rather than individual-level |
| Justification [R2, R5, R6, 47, 103,124] | The extent to which exchange of validity claims are accompanied by reasoning | Appropriate as an individual-level measure, and fits the focus of this study on individuals’ quality of participation that advances policy deliberation |
| Reflexibility [R2, 34, 47] | The extent to which participants critically examine their values, assumptions, and interests, as well as the larger social context | As noted in the previous literature [R2, 46], this aspect is largely an internalized process that takes place in the minds of individuals, thus may not be reflected in participants’ postings |
| Ideal role taking [R2, 34, 124] | The extent to which the discussion is ongoing (characterized by continuous, lasting debate on a focal issue) and the participants are respectful of each other during the process | More appropriate as a collective-level measure, i.e., whether discussion has been occurring in a healthy manner |
| Sincerity [R2, 34] | The extent to which participants make a sincere effort to make known all relevant information and their true intentions, interests, needs, and desire | Measuring this could be problematic [46]. The current approach that relies on counting instances of deception (e.g., the use of false nickname, a low occurrence of which indicates sincerity) may lead to biased conclusion since it is difficult to clearly define or detect deception |
| Inclusion [R5, 46] | The extent to which citizens who are affected by or interested in the issues under discussion are able to participate | This is less prominent in the OPDF under study due to its open nature that allows all interested citizens to participate. Also the country where the OPDF is hosted enjoys a high Internet penetration rate. Thus, the Internet connection required to access the OPDF is not a serious issue |
| Discursive equality [R2, 47] | The extent to which all participants are equally treated during their participation in the discussion | More appropriate as a collective-level rather than an individual-level measure |
| Autonomy [46, 47] | The extent to which discussion is driven by the concerns of publicly-oriented citizens rather than by money or administrative power | Since influences of money or administrative power are external to the postings, they cannot be directly assessed from the postings. However, using justification of arguments as a measure of quality should be able to overrule such influences to some extent |
| Mutual respect  [R5, R6] | The extent to which discussions are characterized by high civility and politeness. Civility refers to an absence of discursive actions that assign stereotypes and the absence of threats to others’ rights and/or democracy; whereas politeness refers to the absence of such rhetorical cues that give a rude impression in the discussion | Conceptualized as a collective-level measure (i.e., participants mutually respect each other during a discussion) rather than an individual-level measure |
| Common good orientation [R5] | The extent to which participants appeal to the common good in their contributions, and encompass the attainment of “greatest good for the greatest number” and helping the least advantaged in a society as a result of their discussion. | More appropriate as a collective-level measure rather than an individual-level measure. Captured to some degree in the Collective Incentives. |

Among the studies using justification, Jensen [47] developed a relatively comprehensive coding scheme consisting of three levels of justification that improved upon the previous dichotomous treatment of this measure [e.g., 124]. The three levels were: *allegation* (claim without any kind of validation or presentation of facts), *internal validation* (claim based on one’s own beliefs and values that are made explicit in the argumentation), and *external validation* (claim based on information from external sources e.g., facts and figures). Steenbergen et al. [103] proposed four levels of justification: *no justification, inferior justification* (a reason is given as to why X should relate to Y but the inference is incomplete), *qualified justification* (a clear inference is made as to why X contributes to or detracts from Y), and *sophisticated justification* (at least two complete inferences are made).

We combine and extend these coding schemes in developing our measure of level of argumentation that reflects individuals’ quality of participation in OPDFs. In delineating the different levels of argumentation we also consult the tripartite theory of knowledge (see [13, 104]), which states that three elements are individually necessary and jointly sufficient for something to be deemed as knowledge, namely belief, truth, and justification. Applied to our study context, an individual needs to justify what he/she believes to be true to demonstrate he/she possess the relevant knowledge that can contribute towards policy deliberation.

For inputs without any justification, a score of 1 (Table 1) is assigned as in [47] and [103]. Such inputs may be mere allegations and would contribute least to deliberation [47, 103]. They do not demonstrate one’s possession of relevant knowledge for advancing policy deliberation.

To better delineate the different extents of internal validation proposed by Jensen [47], we follow Steenbergen et al. [103] in employing two levels: a score of 2 to capture arguments based on internal logical reasoning through analogies or inferences but which is ambiguous; and a score of 3 to capture those made with clear internal logical reasoning (Table 1). While satisfying the basic requirement of deliberative argumentation and knowledge possession, i.e., justification of what one believes to be true through internal logical reasoning, arguments with internal validation are based purely on personal beliefs [46], and their feasibility and reliability are uncertain.

In deriving the higher levels of argumentation, we consider Steenbergen et al. [103]’s *sophisticated justification* to be less appropriate than Jensen [47]’s *external validation*. We find it rather simplistic to treat arguments made with more than one justification as higher quality than those with one justification[[1]](#footnote-1) thus we coded each justification independently. However, instead of progressing directly to external validation as suggested in [47], we refined the higher levels of argumentation by adding the use of personal experience to argue (score of 4 in Table 1). Its use is found to be prevalent in deliberative exercises [92], but has not been considered in [47] or [103]. Per the tripartite theory of knowledge [104], personal experience constitutes a source of evidence that can help in better justifying one’s possession of knowledge. Burkhalter et al. [R1] also note that personal experience is a valid form of information on which to base deliberative claims. It involves bearing witness to or offering personal testimony for one’s argument [R1, R4]. Such information is grounded in reality, i.e., an account of what one has been through, and may be able to induce the empathy of others and help them appreciate the viewpoint presented. Thus, compared to the levels of argumentation based on internal validation (scores of 2 and 3), we consider the use of personal experience to be higher as it transcends personal held beliefs that may be logically correct but remain unverified in practice.

The use of personal experience is, in turn, considered to be of lower argumentation than externally validated sources of information (score of 5). The latter involves generalized facts, figures, and observations that are considered more objective and convincing; they go beyond beliefs and experiences originating from specific individuals that may be prone to individual biases [R3, 47]. Compared to other information sources they may be considered to have a higher objective probability of truth that is needed for knowledge justification. Hence, we classify argumentation based on externally validated sources to be the highest level since this should be most effective in advancing policy deliberation by avoiding potential doubts (e.g., about the extent of truthfulness of the personal experiences) and concerns (e.g., about the feasibility and reliability of the proposed logic).

**Table A3. Examples of Discrepancies in Coding and How They were Resolved**

|  |  |  |  |
| --- | --- | --- | --- |
| **Sample posting** | **Rater 1** | **Rater 2** | **Consensus/Resolution** |
| *“I suggest to think of the problem (about more extended smoking ban) in terms of cars. Like cars, cigarettes or smoking products should be sold only at government authorized and licensed firms. All other points of sale should be discontinued.”* | 2 | 3 | Rater 1 felt the logical reasoning of the argument is ambiguous as the participant did not elaborate on the ways in which cars and cigarettes share similar characteristics. Rater 2 provided a score of 3 by using his own understanding of the possible links between cars and cigarettes (both products could cause societal problems if not being used appropriately, thus necessitating government’s intervention).  The consensus was that a score of 2 would be more appropriate, given the participant needed to be more explicit in his/her logical reasoning, and not all people could understand the possible links between the two products. Through the discussion Rater 2 also came to understand that a participant’s posting should fulfill the preceding requirements to deserve a score of 3. |
| *“My opinion is that any presidential candidate who is above 70 should automatically be disqualified. If an elected presidential candidate is 69 at the time of being elected and is given a term of 6 years, by the time he completes the term, he will be 75 and thus, he should make way for the younger qualified ones.”* | 3 | 2 | Rater 1 coded a score of 3 for the posting based on his own deduction that people reaching the age of 75 would be physically unfit to assume the role of a nation’s leader. Rater 2, however, argued that the participant did not make it clear why an age of 75 would imply one’s being unsuitable for the position, and noted there are/were in fact several national leaders who lead/led a country at similar ages, e.g., Raul Castro (Cuban president, currently 87 year old) and Ronald Reagan (former US president, left office at the age of 77).  Hence, the two raters reached consensus that a score of 2 would be more appropriate. Rater 1 also noted that he would be more cautious by making sure not to apply his own assumptions in his subsequent coding. |
| *“I am in agreement with the notion of extending the ban on smoking to more public areas. This is because smoking is a heinous health issue and is even more worrying when the general public, many of whom are non-smokers, are exposed to second-hand smoke. Second-hand smoke contains as many as 4000 different toxic chemicals which can cause numerous health problems to non-smokers. "Heart disease mortality as well as lung and nasal sinus cancers have been causally associated with second-hand smoke exposure." (Quoted from:* [*http://www.health.gov.mt/health\_services/healthpromotion/-*](http://www.health.gov.mt/health_services/healthpromotion/-)  *secondhandsmoke.htm) Therefore, in my opinion, extending the ban on smoking in more public places will better protect non-smokers (especially children, pregnant women and people who suffer from asthma or other diseases associated with, or result in breathing difficulties) against the harmful effects of second-hand smoke.”* | 5 | 3 | While Rater 1 noted the use of external source by the participant to support his argument (thus coded a score of 5 for the posting), Rater 2 overlooked the use of the external source and coded a score of 3 on the basis that the argument appeared logical.  A clear consensus was reached that a score of 5 should be coded for the posting, and Rater 2 noted that he would subsequently pay close attention to when external sources were appropriately used and make sure to code 5 for such inputs. |

**Table A4. Results of Factor Analysis**

|  |  |  |  |  |  |  |  |
| --- | --- | --- | --- | --- | --- | --- | --- |
|  | Component | | | | | | |
| 1 | 2 | 3 | 4 | 5 | 6 | 7 |
| COLL1 | 0.14 | **0.67** | 0.06 | -0.00 | 0.17 | 0.17 | 0.14 |
| COLL2 | 0.18 | **0.88** | 0.02 | -0.03 | 0.18 | 0.10 | 0.04 |
| COLL3 | 0.11 | **0.88** | 0.05 | -0.08 | 0.15 | 0.11 | 0.05 |
| COLL4 | 0.24 | **0.84** | 0.07 | 0.00 | 0.14 | -0.04 | 0.16 |
| COLL5 | 0.11 | **0.92** | 0.07 | -0.04 | 0.20 | 0.15 | 0.16 |
| POLC1 | 0.12 | 0.21 | -0.03 | 0.08 | 0.14 | **0.89** | 0.21 |
| POLC2 | 0.17 | 0.12 | -0.03 | 0.07 | 021 | **0.88** | 0.24 |
| POLC3 | 0.15 | 0.13 | 0.00 | 0.09 | 0.13 | **0.88** | 0.27 |
| PERS1 | 0.14 | 0.10 | 0.05 | 0.14 | 0.03 | 0.27 | **0.87** |
| PERS2 | 0.07 | 0.24 | -0.01 | 0.16 | 0.10 | 0.31 | **0.79** |
| PERS3 | 0.16 | 0.20 | -0.02 | 0.05 | 0.28 | 0.18 | **0.80** |
| IPEF1 | 0.14 | -0.13 | -0.01 | **0.83** | -0.08 | 0.01 | 0.00 |
| IPEF2 | 0.06 | 0.01 | 0.20 | **0.83** | 0.05 | 0.01 | 0.15 |
| IPEF3 | 0.12 | -0.02 | 0.06 | **0.89** | 0.07 | -0.01 | 0.08 |
| IPEF4 | 0.02 | 0.00 | 0.00 | **0.82** | 0.01 | 0.18 | 0.07 |
| EPEF1 | 0.17 | 0.27 | 0.01 | 0.01 | **0.84** | 0.09 | 0.09 |
| EPEF2 | 0.19 | 0.25 | -0.06 | 0.06 | **0.85** | 0.11 | 0.10 |
| EPEF3 | 0.08 | 0.26 | 0.06 | 0.06 | **0.87** | 0.04 | 0.16 |
| EPEF4 | 0.03 | 0.06 | 0.16 | -0.08 | **0.56** | 0.27 | 0.02 |
| CONN1 | 0.27 | 0.11 | **0.82** | 0.16 | 0.07 | 0.06 | 0.03 |
| CONN2 | 0.17 | 0.07 | **0.89** | 0.18 | 0.02 | -0.08 | -0.01 |
| CONN3 | 0.19 | 0.03 | **0.91** | -0.00 | 0.06 | -0.06 | 0.00 |
| CONN4 | 0.13 | 0.03 | **0.91** | -0.04 | 0.03 | 0.06 | 0.01 |
| COMM1 | **0.89** | 0.14 | 0.08 | 0.03 | 0.05 | 0.06 | 0.04 |
| COMM2 | **0.90** | 0.12 | 0.14 | -0.01 | -0.01 | 0.14 | 0.01 |
| COMM3 | **0.87** | 0.11 | 0.17 | 0.01 | 0.26 | 0.19 | -0.01 |
| COMM4 | **0.77** | 0.12 | 0.25 | 0.22 | -0.00 | 0.07 | 0.15 |
| COMM5 | **0.77** | 0.19 | 0.16 | 0.18 | 0.17 | 0.04 | 0.19 |
| COMM6 | **0.74** | 0.24 | 0.22 | 0.16 | 0.26 | 0.03 | 0.17 |
| Eigenvalue | 9.07 | 4.02 | 3.23 | 2.18 | 1.97 | 1.68 | 1.17 |
| Variance  Explained (%) | 31.27 | 13.85 | 11.15 | 7.50 | 6.78 | 5.78 | 4.05 |
| Cumulative variance (%) | 31.27 | 45.12 | 56.27 | 63.77 | 70.55 | 76.33 | 80.38 |

**Table A5. Weights of Formative Measures**

(^p≤0.10, \*p≤0.05, \*\*p≤0.01, \*\*\*p≤0.001)

|  |  |  |  |  |  |  |
| --- | --- | --- | --- | --- | --- | --- |
| Formative Construct | Dimension | Mean | St. Dev | Weight | t-value | VIF |
| Political Efficacy (PEFF) | IPEFF | + | + | 0.57 | 2.84\*\* | 1.003 |
| EPEF | + | + | 0.78 | 5.37\*\*\* | 1.003 |
| Civic Skills (CIVC)  Note: “W” in W.CIV refers to civic skills practiced at the *workplace*; “V” refers to that at the *voluntary organizations*; and “R” refers to *religious institutions* | W.CIVC | + | + | 0.36 | 5.23\*\*\* | 1.239 |
| V.CIVC | + | + | 0.47 | 10.24\*\*\* | 1.520 |
| R.CIVC | + | + | 0.42 | 8.51\*\*\* | 1.470 |
| W.CIVC1 | 2.19 | 1.28 | 0.35 | 1.98\* | 2.412 |
| W.CIVC2 | 2.43 | 1.49 | -0.19 | 0.81 | 3.683 |
| W.CIVC3 | 1.99 | 1.31 | 0.23 | 0.88 | 4.071 |
| W.CIVC4 | 1.97 | 1.25 | 0.49 | 2.42\* | 4.028 |
| W.CIVC5 | 2.26 | 1.37 | 0.21 | 1.05 | 2.965 |
| V.CIVC1 | 2.08 | 1.20 | 0.21 | 1.40 | 2.673 |
| V.CIVC2 | 2.04 | 1.26 | 0.24 | 1.85\* | 4.469 |
| V.CIVC3 | 1.68 | 1.02 | 0.48 | 3.35\*\* | 3.190 |
| V.CIVC4 | 1.78 | 1.17 | -0.07 | 0.40 | 4.259 |
| V.CIVC5 | 1.88 | 1.15 | 0.26 | 1.80\* | 2.725 |
| R.CIVC1 | 1.67 | 1.00 | 0.28 | 3.15\*\* | 2.453 |
| R.CIVC2 | 1.68 | 1.04 | -0.03 | 0.24 | 5.300 |
| R.CIVC3 | 1.33 | 0.69 | 0.40 | 3.28\*\*\* | 3.137 |
| R.CIVC4 | 1.47 | 0.82 | 0.26 | 1.69\* | 5.128 |
| R.CIVC5 | 1.50 | 0.84 | 0.23 | 1.66^ | 3.808 |

+ Not directly measured. Formed by the first-order constructs

References\*:

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[R6] Zhang, W., Cao, X., Tran, M.N. The structural features and the deliberative quality of online discussions, *Telematics and Informatics*, 30, 2(2013.), 74-86

\* Note: The references not appearing in the main manuscript are provided here

1. In our initial coding we found a sizeable number of instances where participants attempted to provide two or more justifications, which could vary in their quality. For instance, a participant might provide three justifications, one of which had internal logical reasoning that was clear, while the other two were ambiguous. It might be a misjudgment to conclude this as having a higher quality than those made with two clear internal logical reasoning, or at the same level with those with three justifications all made with clear internal logical reasoning. Due to these observations, we separately coded each justification/argument for an idea or view. [↑](#footnote-ref-1)