

Core-Periphery Value Dynamics in Peer Production Community Systems

Mercedes Ross

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Committee:

Benjamin Mako Hill

Adrienne Russell

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Mercedes Ross

University of Washington

Abstract

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Mercedes Ross

Chair of the Supervisory Committee:

Benjamin Mako Hill

Department of Communication

Peer production communities generate much of the world's shared knowledge through decentralized collaboration among contributors with varying levels of participation. This study addresses a foundational question: *Who provides value in these environments, and what kinds of value do different contributor groups offer?* I examine how changes in core and peripheral membership influence knowledge production, and how peer production systems function when either group is diminished or absent.

I analyze a natural experiment created by the 2012 split between Wikitravel and Wikivoyage, which produced two communities with contrasting contributor structures: one (Wikivoyage) that retained a strong core but a smaller periphery, and another (Wikitravel) that retained a large periphery but lost most of its core contributors. Using difference-in-differences models applied to article-level data, I compared long-term changes in information production (article length) and polish (structured listing tags).

The results show that Wikivoyage experienced faster sustained growth in both information and polish after the split, while Wikitravel grew more slowly despite continued peripheral participation. These findings suggest that core contributors play a central role in coordinating and sustaining long-term knowledge production, while peripheral contributions alone are insufficient to support comparable growth.

Introduction

The Newton and Ortega hypotheses are influential ideas, drawn from the history and philosophy of science, about where and how new knowledge is produced. These competing hypotheses have been adapted to explain the source of value in peer production communities like Wikipedia. In online communities, the Newton hypothesis suggests that progress depends on a small group of highly active individuals, often referred to as the “core.” Others take a perspective closer to Ortega's view, in which less-involved contributors, sometimes called the “periphery,” play a crucial role by introducing new perspectives, local knowledge, or information that would otherwise be missed. This tension is central to understanding how collaborative knowledge systems function and evolve. Many studies find that the most active contributors provide the greatest value because they contribute more often, take on coordination tasks, and help maintain community standards (Crowston et al., 2006; Kittur et al., 2007; Kittur & Kraut, 2008; Panciera et al., 2009; Safadi et al., 2021). Other work emphasizes the importance of less active participants, who may contribute new or overlooked information that expands the knowledge base in important ways (Ortega et al., 2008; Gorbatai, 2014; Chhabra & Iyengar, 2020). Untangling the independent value of each group is difficult because core and peripheral members are usually both present and interacting simultaneously within the same community.

This study explores the core-periphery dynamic by examining a rare case of a fractured community that serves as a natural experiment. In the travel guide community Wikitravel, nearly all core members left the original site to launch a new project called Wikivoyage, while most peripheral participants remained. As a result, one community retained a strong core but lost much of its periphery, while the other kept its periphery

but lost most of its core. This fracture offers a rare opportunity to isolate and analyze the distinct contributions of core and peripheral members. In this context, I distinguish between two dimensions of value: polish, which refers to the refinement and standardization of existing content, and information volume, which captures the amount of informational content added, including new facts, perspectives, or locally specific knowledge not previously included. In this study, information volume is operationalized as article length (in characters). Although length is an imperfect proxy, prior research suggests that longer articles tend to reflect the accumulation of additional information over time, making it a reasonable measure of informational contribution at scale. I ask: *Are core members primarily responsible for polish? And are peripheral members a more important source of information than core members?* These questions build on longstanding debates in the literature on peer production and value in online communities, including debates often framed in terms of the the Newton and Ortega hypotheses, which offer competing views about whether a small group of highly active contributors (the core) or a broader base of less active contributors (the periphery) drives progress in collaborative systems.

This paper contributes to the scholarship on peer production and collaborative online communities by empirically disentangling the effects of core and peripheral contributors on the development of information artifacts. Theoretically, I test hypotheses about contributor roles using the 2012 Wikitravel-Wikivoyage split as a natural experiment. Methodologically, I introduce a scalable approach for measuring polish and information volume in the context of peer production wikis. Empirically, I show that following the 2012 split, Wikivoyage rebuilt a strong core and experienced faster growth in both article length and listing tags, while Wikitravel, despite retaining a

larger periphery, did not exhibit comparable increases. These results suggest that core contributors play a critical role in sustaining both content growth and the refinement of existing information.

The remainder of the paper proceeds as follows: I begin with a review of prior work on peer production and contributor roles, then I describe the Wikitravel-Wikivoyage split, which serves as my empirical setting. Next, I introduce my research design, measurement approach, and analytic plan. Next, I report the results of two models comparing the development of information artifacts across the two communities. Finally, I conclude with a discussion of the theoretical and practical implications of my findings.

Background

A central debate across philosophy, science studies, and the social and information sciences concerns how valuable knowledge is produced and who contributes most meaningfully to it (Cole & Cole, 1973; Benkler et al., 2015; Bornmann et al., 2010; Chhabra & Iyengar, 2020). This question has become especially important in online peer production communities, where large numbers of individuals freely collaborate to produce shared information resources outside of traditional market or hierarchical organizations (Benkler, 2002; Wasko & Faraj, 2005; Benkler et al., 2015).

Peer production communities bring together contributors with varying levels of activity and expertise, ranging from highly engaged core members to less frequent peripheral participants. Prior research has shown that these groups often play different roles in shaping collaboratively produced knowledge, raising questions about whether a small core of highly active contributors is essential for sustaining growth and quality, or whether contributions from a broader periphery provide equally important value

(Crowston et al., 2006; Kittur et al., 2007; Chhabra & Iyengar, 2020). These competing perspectives motivate the central question of this study: *how do core and peripheral contributors differ in the quantity and quality of knowledge they produce in peer production communities?*

Scholars of peer production have framed this question in terms of a long-standing debate in the philosophy and sociology of science commonly described as the Newton and Ortega hypotheses (Bornmann et al., 2010; Cole & Cole, 1973). The Newton hypothesis, drawing on Isaac Newton's reference to "standing on the shoulders of giants," argues that meaningful progress is driven primarily by a small group of elite contributors, while the contributions of most others are relatively unimportant over the long term. In contrast, the Ortega hypothesis, named after philosopher José Ortega y Gasset, emphasizes the cumulative importance of many modest contributions, arguing that routine and incremental work by less prominent contributors plays an essential role in advancing collective knowledge.

Although these hypotheses were originally developed to explain patterns of scientific production, more recent scholarship has applied them to peer production communities to understand how different contributor groups generate value (Bornmann et al., 2010; Chhabra & Iyengar, 2020). When invoked by scholars of peer production, the Newton hypothesis is the argument that a small, highly active core is sufficient to drive progress, while peripheral contributions may be low-quality or disruptive. The Ortega hypothesis instead emphasizes the importance of medium and low-activity contributors, particularly for adding new information, perspectives, or domain-specific knowledge that the core may lack (Chhabra & Iyengar, 2020).

Although not all scholars interested in the sources of value in peer production invoke the Newton and Ortega hypotheses, empirical and theoretical work on peer production has long debated whether value creation is driven primarily by a small group of highly active contributors or by the aggregate contributions of many peripheral participants. Early studies of Wikipedia showed that a small number of highly active users were responsible for a large share of edits, supporting the view that core contributors generate most of the value in collaborative knowledge systems (Kittur et al., 2007). Wikipedia founder Jimmy Wales similarly argued that a small group of dedicated editors contributes disproportionately to content development and maintenance, a pattern that is readily observable in public Wikipedia data. Although not always labeled that way, this perspective aligns closely with the Newton hypothesis applied to peer production.

Other work challenges this interpretation by emphasizing the role of peripheral contributors in supplying substantive new information. For example, Swartz (2006) responded directly to Wales, arguing that when one editor adds new material and others later revise it, treating all edits equally inflates the apparent contribution of core contributors while obscuring the substantive role of peripheral authors. Ortega et al. (2008) later formalize this critique, showing how edit-based measures systematically bias estimates of contribution. Empirical studies provide partial support for this view, showing that peripheral users generate a significant share of new content, while core users are more involved in coordination and polish (Ortega et al., 2008; Chhabra & Iyengar, 2020). At the same time, the relative balance between core and peripheral contributions varies across communities and language editions, suggesting that neither

perspective alone fully explains patterns of value creation in peer production systems (Ortega et al., 2008).

Evaluating the Newton and Ortega hypotheses in peer production communities is challenging because core and peripheral roles are often interdependent. Prior research shows that activity by one group is closely linked to that of the other group, producing feedback loops rather than isolated contributions (Gorbatai, 2014; Hill & Shaw, 2021). Peripheral contributors may introduce new or missing content that core members later refine, reorganize, or remove, particularly when contributions do not align with community standards or formatting norms (Chhabra & Iyengar, 2020; Kittur & Kraut, 2008). Even substantively valid edits are sometimes reverted due to newcomers' unfamiliarity with local conventions (Panciera et al., 2009; Halfaker et al., 2013). These interactions often lead contributors to revise and resubmit their work, creating an iterative process of negotiation and polish (Crowston et al., 2006; Benkler et al., 2015). As a result, knowledge artifacts are co-produced through ongoing interaction, complicating efforts to attribute value cleanly to either core or peripheral contributors alone.

This study addresses that challenge by examining a rare case in which core and peripheral contributors became largely separated, allowing their distinct contributions to knowledge production to be observed more directly. This separation creates unusual leverage for evaluating the Newton and Ortega hypotheses, which are typically difficult to test in intact communities where roles overlap. Using an organizational split as a natural experiment, I examine how differences in core–periphery size shape both the quantity and quality of collaboratively produced content in peer production communities.

Open participation is a defining feature of peer production communities and depends on contributions from individuals who are not fully integrated into the core group (Benkler, 2002; Benkler et al., 2016). These loosely affiliated contributors can introduce knowledge, perspectives, or expertise that established members may not possess. Research on knowledge exchange shows that ties to outsiders, who are less constrained by existing routines or norms, can provide access to novel and diverse information (Anand et al., 2002; Wasko & Faraj, 2005; Nooteboom, 1999). In peer production settings, peripheral contributors may bypass internal coordination structures and add content that would otherwise remain absent. This pattern has been observed across a range of knowledge-intensive communities (Powell et al., 1996). At the same time, the value of these contributions depends on whether communities can incorporate them into ongoing development processes, as projects that fail to integrate external input may stagnate rather than grow.

As peer production communities grow, they often shift from loosely organized collaboration toward more structured forms of coordination. Although these communities are designed to remain open and lightly governed, increases in scale raise coordination demands, often leading to the emergence of core-periphery structures (Benkler et al., 2016; Kittur et al., 2007; Matei & Britt, 2017). Within these structures, a small core group contributes more frequently and assumes responsibility for maintaining norms, coordinating work, and ensuring content quality (Crowston & Howison, 2005). Peripheral contributors continue to play an important role but participate less often and in a more decentralized manner (Crowston et al., 2006; Panciera et al., 2009; Wasko & Faraj, 2005). Here, decentralized participation refers to

small, independent contributions that are not embedded in ongoing coordination or oversight processes.

Although peer production projects vary widely in purpose and form, all are organized around a shared information artifact (IA), such as an article, software tool, or dataset. In article-based communities, most notably Wikipedia, these IAs take the form of articles whose value depends on accuracy, relevance, and ongoing maintenance.

Within peer production communities, participation is highly uneven. A small group of highly active contributors, referred to as core members, accounts for a disproportionate share of edits and interactions, while the majority of contributors participate infrequently or sporadically (Crowston et al., 2006; Kittur et al., 2007; Panciera et al., 2009; Ortega et al., 2008). This skewed pattern of participation gives rise to core-periphery structures, in which a dense core of frequent contributors is surrounded by a much larger periphery of occasional participants.

Peripheral contributors are typically defined in the literature as low-activity participants who are not deeply embedded in coordination or governance processes. Prior research defines peripheral contributors as those who participate at low to moderate levels and are less fully integrated into community routines and social structures (Crowston et al., 2006; Kittur et al., 2007). Because they participate less frequently, peripheral members are often less familiar with established norms and conventions, and are less consistently engaged in maintenance or coordination work.

Core members sustain coordination, maintenance, and polish within peer production communities. Prior research characterizes core contributors as highly active participants who are deeply embedded in community practices and disproportionately involved in governance and coordination activities (Crowston et al., 2006; Kittur et al.,

2007). Because of their sustained engagement, core members are more likely to monitor content quality, enforce norms, and perform coordination-intensive work such as organizing, standardizing, and refining existing material.

Prior research suggests this exact division of labor within peer production communities. Core contributors are more likely to engage in coordination, maintenance, and polishing of existing content, while peripheral contributors more often introduce new or missing information (Kittur et al., 2006; Chhabra & Iyengar, 2017). Research on weak ties further suggests that peripheral participants can introduce novel or non-redundant knowledge that is not yet embedded in the community's existing base (Granovetter, 1973; Wasko & Faraj, 2005). In large-scale systems such as Wikipedia, peripheral users frequently contribute niche or underrepresented information that complements the work of core members (Halfaker et al., 2013; Panciera et al., 2009; Chhabra & Iyengar, 2020). This labor structure suggests that core and peripheral contributors may differentially shape information production and content polish.

Theoretical Framework and Hypotheses

To answer my research question about how changes in core and peripheral membership influence information production and polish in peer production communities, I test two hypotheses closely modeled on peer production scholars' invocation of the Newton and Ortega hypotheses. To do so, I focus on two key dimensions of content value in peer production communities: information volume and polish. These dimensions correspond to two core functions in collaborative systems: expanding the knowledge base and refining existing contributions. I present two hypotheses, each targeting one of these functions.

Value in peer production is multidimensional. In the case of collaboratively written travel guides, information artifacts (IAs) are ideally current, relevant, accurate, and well-structured. While a high volume of contributions can indicate engagement, simple edit counts can be misleading: not all edits are equal, and some may consist of minor changes or even vandalism (Swartz, 2006). Rather than evaluating individual edits, which vary widely in size and significance, I analyze patterns of contribution at the article-week level to capture broader dynamics of knowledge production.

In addition to differences in contributor composition at a given point in time, prior work suggests that changes in core and peripheral membership over time can shape how peer production communities evolve. Core contributors are typically responsible for refining content, maintaining standards, and coordinating editorial practices (Crowston & Howison, 2005; Kittur et al., 2007). When their numbers decline, this oversight tends to weaken, allowing more unrefined or inconsistent content to persist. Meanwhile, peripheral contributors often provide novel, local, or underrepresented information (Safadi et al., 2021; Kittur & Kraut, 2008). If peripheral activity decreases, the flow of new information may slow, limiting the community's ability to grow its knowledge base.

Core contributors are expected to improve information artifacts through coordination, maintenance, and refinement activities that sustain the system's overall quality and structure. Peripheral contributors often expand the system's informational scope by introducing new or niche material, though their contributions may sometimes be incomplete or less well integrated with existing content. In wiki communities, for example, core contributors frequently perform maintenance tasks such as correcting errors, enforcing formatting conventions, and integrating contributions from newer

editors. Both groups play a role in shaping the value of an IA, albeit through different pathways.

Based on prior research suggesting that peripheral members are more likely to introduce new material (Crowston et al., 2006; Kittur et al., 2007; Chhabra & Iyengar, 2020), I expect that peer production communities with larger peripheries will produce more information over time. These expectations lead me to my first hypothesis that:

(H1) *Larger peripheries will be associated with more information.*

While peripheral contributors are more likely to add new content, including new text, new facts, and new observations, core contributors often engage in editing for clarity, structure, consistency, and adherence to community norms. I refer to this latter form of contribution as polishing, the process of improving and aligning existing content with standards of quality. Polishing may involve removing vandalism, correcting errors, standardizing formatting, or adding references. Together, these contributions help ensure that the resulting information artifacts are not just plentiful but coherent and trustworthy. Based on prior work identifying the polish and coordination roles of core contributors (Kittur et al., 2007; O'Mahony & Ferraro, 2007), I expect that communities with larger cores will exhibit higher levels of polish over time. These expectations lead me to my second hypothesis that: **(H2)** *Larger cores will be associated with higher rates of polish.*

Empirical Setting: Wikivoyage and Wikitravel

Wikitravel is a peer produced travel guide designed to provide up to date information about destinations, including excursions, restaurants, accommodations, and local highlights. Like Wikipedia, it consists of publicly editable articles, or

information artifacts (IAs), maintained by a mix of highly active core contributors and less frequent peripheral participants.

In 2006, the commercial company Internet Brands purchased Wikitravel and operated the site as a commercial travel guide supported by advertising. Over time, tensions developed between Internet Brands and the volunteer editing community, particularly among core contributors who had previously overseen coordination and quality control. In October 2012, after disputes over governance and the removal of administrative privileges, nearly all core contributors left Wikitravel and launched a new site, Wikivoyage. The new project was hosted by the Wikimedia Foundation and governed by the former core members. Using publicly available database dumps distributed under the Creative Commons BY-SA license, Wikivoyage was populated with content that was identical to Wikitravel at the time of the split. As a result, Wikivoyage began with the same content base as Wikitravel and operated under the same technical conditions, one with ads and one without.

This organizational split produced two parallel communities that were similar in topic, format, and initial content, but sharply different in contributor composition. To verify this divergence, I examine the number of core and peripheral contributors in each community over time. Figures 1 and 2 display these trends. Following the split, Wikivoyage shows a sustained concentration of core contributors but a comparatively smaller periphery. In contrast, Wikitravel retains a larger peripheral base but experiences a substantial decline in core membership. These patterns confirm that the split created two communities with contrasting core-periphery balances.

Because the communities began with nearly identical content and technical structures but diverged in contributor composition, the split provides a rare natural experiment for examining how differences in core and peripheral membership shape knowledge production over time. Importantly, although the number of core and peripheral contributors fluctuate substantially in the months following the launch of Wikivoyage, my analyses do not model these short-term compositional changes directly. Instead, I use the post-split divergence in contributor balance over time as a validation check to confirm that Wikivoyage retained a relatively stronger core while Wikitravel retained a relatively larger periphery. My primary interest is not the week-to-week variation in contributor counts, but how these structural differences influenced the trajectory of content development after the split.

Data & Measures

Research Ethics

This study draws on publicly available data from Wikitravel and Wikivoyage, two peer-produced travel guide communities. The data were obtained from Wikimedia content dumps and cover activity between August 4, 2003 and September 1, 2016. Each community is identified by a project code (WT for Wikitravel, WV for Wikivoyage), and identical data extraction and processing procedures were applied to both datasets.

This study does not require Institutional Review Board (IRB) approval because it relies exclusively on publicly available data and involves no interaction or intervention with human subjects. Substantively similar research using Wikitravel, Wikivoyage, and similar peer production communities has been reviewed by the University of

Washington IRB and determined not to constitute human subjects research under applicable U.S., state, and university regulations.

Data Collection and Preparation

To enable reliable comparison across communities, I began by cleaning the raw edit histories from Wikitravel and Wikivoyage. This involved filtering for substantive contributions by excluding rows with missing editor information, limiting to edits in the main namespace (i.e., only article texts themselves and not discussion pages), and standardizing article titles and contributor identifiers. I also excluded contributions from a small set of known automated bot accounts to focus on human participation.

Redirect pages were also removed to ensure that analyses reflect engagement with meaningful content rather than navigational artifacts. Redirects are non-substantive pages that automatically forward users to other articles, often serving as alternative spellings or synonyms. If retained, these pages could artificially inflate or deflate activity metrics by appearing as underdeveloped or inactive despite not being designed to hold content. Prior work has shown that redirects can significantly distort assessments of article activity (Hill & Shaw, 2014). I processed and removed redirects separately for each community, ensuring that all subsequent analyses focused solely on original content pages.

I identified redirect pages using string pattern detection, specifically by scanning for the keyword #REDIRECT within the article text. Redirects were flagged across both communities and removed before aggregation and analysis. All subsequent measures,

such as article length and counts of polish indicators, were calculated using only non-redirect pages.

Community Coding and Comparison Design

I processed the complete edit histories of Wikitravel and Wikivoyage separately, applying the same cleaning scripts and criteria to each dataset to ensure consistency. Each edit, article, and contributor was labeled based on the project from which the data originated (Wikitravel or Wikivoyage).

Main Dataset Construction

I constructed my main dataset by processing the complete revision histories of Wikitravel and Wikivoyage. Each dataset was cleaned using a standardized script to ensure comparability across communities. Revisions were filtered to include only edits made in the main namespace, and contributions from known bot accounts were removed using a predefined list of usernames. Timestamps were converted into standardized datetime formats, and edits were grouped into consistent seven-day intervals to support longitudinal analysis. For each article, I computed cumulative weekly metrics including article length (measured in characters) and counts of structured listing tags. Article length serves as a proxy for the volume of information contained in an article, while listing tags capture the use of standardized templates for items such as restaurants, hotels, and attractions and therefore provide an indicator of article polish. Data from each community were processed separately to preserve internal consistency and prevent cross-contamination.

Because Wikivoyage originated as a fork of Wikitravel, many articles exist in both communities with the same or closely corresponding titles. To ensure comparability between the two projects, I restricted the analysis to paired articles that appear in both Wikitravel and Wikivoyage. Articles that existed in only one community were excluded. This restriction ensures that each observation represents the evolution of the same destination or topic across both projects, allowing for a more direct comparison of how content develops after the split.

To examine temporal trends in content development, I aggregated edits by article, community, and week. Each record is timestamped with a reference date marking the beginning of the seven-day period and labeled by article title and community identifier. I also generated a list of standardized weekly cutoff dates, ensuring consistency in week-to-week comparisons across the dataset. The first week of data was excluded from analysis due to the absence of a preceding time point needed to calculate change metrics. This structure allows for a reliable, time-aligned comparison of knowledge production across communities. The final dataset contains 7,465 paired articles across the two communities, yielding 6,531,448 article-week observations.

Sample Construction

I constructed a longitudinal dataset that aggregates edits into seven-day intervals. For each article, edits were grouped by project and week, producing a consistent temporal structure that allows comparisons across communities. Weekly changes in article length and listing tags capture changes in information production and article polish over time.

Measures

To examine the relationship between contributor roles and knowledge production, I constructed measures representing core membership, periphery membership, amount of information, and polish. There is no single standard for identifying core and peripheral contributors in peer production communities. As Crowston et al. (2006) explain, the “core” can be defined in several ways, including through social network centrality, activity levels, or status roles such as administrator or bureaucrat. Their study concludes that the appropriate definition depends on the concept being measured. Although I initially considered using status-based definitions of the core (e.g., administrator or bureaucrat roles), these roles did not consistently reflect sustained contribution to article development. Contributors can move into and out of formal roles for administrative reasons, and these roles often change independently of editing activity. As a result, role-based definitions did not reliably capture the contributors most actively shaping the knowledge base. Instead, I used activity-based thresholds to identify contributors who were substantively engaged in producing and refining content over time.

To measure the number of core users, I adopted an activity-based threshold inspired by Panciera et al. (2009), who classified core contributors in Wikipedia as those who made more than 250 edits over their lifetime. I diverged from this lifetime-based definition because my analysis focuses on short-term dynamics and temporal change following a community split, rather than cumulative participation over many years.

Instead, I define core contributors as users who made more than 100 edits or more within a 30-day period. This threshold captures contributors who are intensely active within a given time window, reflecting sustained engagement and visibility during periods of community transition. A monthly window allows me to track changes in contributor composition over time and aligns with Wikimedia's own benchmarks for identifying highly active contributors. While the specific cutoff is necessarily somewhat arbitrary, users exceeding 100 edits in a month are clearly distinct from typical contributors and represent a conservative definition of a highly active core.

I measure peripheral users as those making less than 5 edits per month. The Wikimedia Foundation defines 'active editors' as those who make at least five edits per month (Wikimedia Foundation, n.d.). I define peripheral members as users who make fewer than five edits in a given month, aligning with this benchmark and prior studies (e.g., Ortega et al., 2008; Chhabra and Iyengar, 2020).

As Howison (2011) notes, measures of participation vary across studies and communities, and researchers often tailor thresholds to the nature of their empirical setting and analytic goals. In both cases, I believe that my measures represent conservative thresholds that aim to capture the essence of core and periphery without overlap from mid-level contributors. Although the numbers are obviously debatable, my rationale is that users who make more than 100 edits in a month are substantially more active than those who make fewer than five.

Postsplit is a binary indicator equal to 1 for observations dated after January 1, 2013, and 0 otherwise, capturing the post-split period after the Wikitravel-Wikivoyage fork, with the cutoff aligned to the first full weeks following the October 2012 split.

Amount of information is measured using the character length of articles. Article length is not a direct measure of accuracy or overall quality, but it is a useful proxy for the volume of contributed content and coverage. Prior research finds that longer Wikipedia articles are often rated more highly on dimensions such as comprehensiveness and coverage (Blumenstock, 2008). Article length does not capture other important dimensions of quality, such as accuracy, neutrality, or adherence to community standards. I therefore treat article length as one dimension of informational value focused on how much content is available to readers. In collaborative travel guides, increases in article length typically reflect the addition of new listings, descriptions, and locally specific details, making length a reasonable proxy for the accumulation of new information over time.

Polish is measured using the number of listing tags in an article. In travel wikis, listing tags are structured templates used to format points of interest such as hotels, restaurants, attractions, or transportation options. These tags follow a specific syntax (e.g., “`{{listing|name=Hotel Plaza|type=sleep|address=123 Main St}}`”) that ensures consistent formatting across articles. For example:

- **Unstructured entry:**

Joe's Tacos, 123 Main Street, cheap eats

- **Structured listing tag:**

```
{{listing | name=Joe's Tacos | address=123 Main Street |
type=eat | price=$ }}
```

Within both Wikitravel and Wikivoyage, articles with a higher number of correctly used listing tags tend to reflect greater attention to structure, clarity, and adherence to community conventions. These tags also make it easier to extract information automatically and to integrate articles with external tools such as maps or travel apps. This measure captures contributors' investment in organizing content in ways that are both reader-friendly and compatible with automated parsing. This interpretation is supported by prior research. Wöhner and Peters (2009) show that structured, template-based editing is correlated with higher-quality Wikipedia articles. Similarly, Halfaker et al. (2013) distinguish between low-effort and high-effort edits and find that structured contributions are linked to sustained engagement and improved article quality. All polish variables were constructed separately for each community using the same procedures, allowing for consistent comparisons across projects.

Time is measured as a continuous variable using the article's weekly reference date, indexed in seven-day intervals. The variable wv is a binary indicator equal to 1 for Wikivoyage and 0 for Wikitravel. The variable $postsplit$ equals 1 for observations occurring after January 1, 2013, which marks the post-treatment period. This variable captures longitudinal change in article development over time.

The variable $postsplit$ is a binary indicator that equals 1 for observations occurring after January 1, 2013, and 0 otherwise. This cutoff marks the period following

the Wikitravel–Wikivoyage split and represents the post-treatment period in the difference-in-differences design.

Together, these final variables define treatment status, time, and the post-split period used in the difference-in-differences models.

Analysis Plan

This study evaluates how shifts in contributor composition, specifically reductions in core or peripheral members, affect the production of information and polish in peer production communities. I estimate these effects using a single difference-in-differences model applied to two outcome measures. All analyses were conducted in R.

To test H1 and H2, I use a difference-in-differences (DiD) design that models changes in growth rates over time. Rather than estimating a single post-treatment shift, this specification captures whether trajectories of information production and polish diverge between communities after the split. This quasi-experimental approach estimates the causal effect of a treatment or intervention by comparing the change in outcomes over time between a treatment group and a comparison group. In this case, I treat Wikivoyage as the “treatment” community that formed after the 2012 fork, and Wikitravel as the comparison. DiD designs are widely used in econometrics and the social sciences to infer causal effects when randomized experiments are not possible (Wooldridge, 2010).

I estimate the following model:

$$Y_{it} = \beta_0 + \beta_1(\text{weeks}) + \beta_2(\text{week} \times \text{postsplit}) + \beta_3(\text{week} \times \text{wv} \times \text{postsplit}) + u_i + \varepsilon_{it}$$

In both models, Y is the outcome of interest, measured as either article-level information (e.g., character length) or polish (e.g., listing count). For analyses of information (H1), I log-transformed article length to account for skew. The variable wv is a binary indicator for Wikitravel, and $postsplit$ marks time periods after January 1, 2013. Time is modeled as a continuous variable measuring the number of weeks since the split date.

I applied this model twice, using two different outcome variables corresponding to my two hypotheses. To test H1, which predicts that larger peripheral contributor bases are associated with greater information production, I used log-transformed article length as the dependent variable. Article length is log-transformed to account for skew and to allow coefficients to be interpreted as proportional growth rates. To test H2, which predicts that communities with stronger core groups exhibit higher rates of polish, I used the number of listing tags per article as the dependent variable. This outcome is modeled in raw units because the measure is much less skewed, and to preserve the interpretability of incremental formatting and organizational work. All other model terms remain identical across both specifications.

The interaction terms capture how growth trajectories change after the split. The coefficient on $(\text{weeks} \times \text{postsplit})$ reflects whether the overall rate of change shifts after the split across both communities. The three-way interaction term $(\text{weeks} \times \text{wv} \times \text{postsplit})$ captures whether the rate of change differs between Wikivoyage and Wikitravel following the split. This term is the primary parameter of interest, as it indicates whether one community exhibits faster growth in information or polish over time after the fork.

The three-way interaction term (*weeks x wv × postsplit*) captures whether the rate of change in information or polish differs between the two communities after the split. For analyses of information production (H1), I additionally estimated a mixed-effects version of this model with random intercepts for articles (titles) to account for persistent baseline differences in article characteristics over time. This slope term is the primary parameter of interest for testing my hypotheses. For H1, I examined whether information growth differs over time between Wikitravel and Wikivoyage following the split. For H2, I examined whether polish increases more rapidly in Wikivoyage, where the core group reassembled, than in Wikitravel. These terms allow me to distinguish short-term disruptions from longer-term differences in developmental trajectories. Because my theoretical framework emphasizes sustained contribution patterns rather than short-term reactions, I treated immediate post-split changes as descriptive rather than confirmatory evidence.

As I discuss below in the section on “Core-Periphery Differences After the Split”, there is evidence, clear from exploratory data analysis and in Figures 1 and 2, that this transitional period includes irregular editing behavior, which could obscure longer-term patterns. For example, I know that users from Wikitravel who wanted to migrate accounts to Wikivoyage were asked to edit both sites. I also know that Wikitravel’s new owners took a range of steps to prevent this, which led to unusual editing behavior. To avoid instability introduced by the community transition, I excluded observations from Wikivoyage between August 2, 2012 (when the Wikivoyage dump was created) and April 1, 2013, after the migration and governance transition had stabilized.

Under the assumption of parallel trends before the split (the two sites were literally the same database before the split), I omit interaction terms for presplit differences and for discontinuous changes at the point of the split. These assumptions are plausible in this setting because both communities shared an identical content base prior to the split and followed nearly identical pre-split trajectories.

Core-Periphery Differences After the Split

The two communities developed very different contributor structures after the split. Figure 1, shows that Wikivoyage quickly rebuilt a strong core group of highly active contributors who made 100 or more edits in a 30-day period. This core grew larger than it had been before the split and remained relatively stable. In contrast, Wikitravel's core became much smaller and did not recover in the following years. This suggests that Wikitravel lost many of the contributors who had been responsible for frequent editing, coordination, and maintenance work.

Figure 2, shows the pattern for peripheral contributors. Wikitravel kept a large number of infrequent contributors, while Wikivoyage had far fewer. This matches the historical description of the split, where most core members moved to Wikivoyage while a broad but loosely engaged periphery stayed on Wikitravel.

These differences in contributor composition are important for interpreting the natural experiment. They show that the split produced two communities with clearly different levels of core and peripheral activity. This is directly related to the theories in the background section, which propose that core and peripheral contributors play different roles in producing information and improving article quality. These structural

shifts create the conditions needed to test those ideas in the difference-in-differences models that follow.

Results

This section presents the results for H1 and H2. Table 1 reports the model estimates, and Figures 3 and 4 show the trends in the data alongside the model-predicted trajectories used to interpret those estimates. Although the Wikitravel-Wikivoyage split occurred in late 2012, differences between the two communities became visible in early 2013. Because the data are grouped into weekly periods, January 1, 2013 marks the beginning of the first full post-split weeks and serves as the cutoff for the post-split period in all analyses.

Table 1 (below) reports the difference-in-differences estimates for information production and article polish. The first column shows results for article length, measured as the log of article characters. The second column shows results for polish, measured as the number of listing tags used to structure travel information within an article. Both models estimate how weekly growth rates change after the Wikitravel-Wikivoyage split and whether those changes differ between the two communities. All models include random intercepts for individual articles to account for persistent differences in baseline article characteristics.

The coefficient for *weeks* indicates that articles grew steadily over time prior to the split. For article length, the baseline growth rate is positive and statistically significant ($\beta = 0.00193$, $p < .001$), indicating that articles increased in size each week before the communities diverged.

The interaction between *weeks* and the *postsplit* indicator shows that this growth rate slowed after the split for the baseline community, Wikitravel ($\beta = -0.00162$, $p < .001$). The key coefficient captures the additional post-split growth rate for Wikivoyage relative to Wikitravel. This estimate is positive and statistically significant ($\beta = 0.00140$, $p < .001$), indicating that after the split, Wikivoyage articles grew faster each week than Wikitravel articles. Because the dependent variable is logged, this coefficient represents an additional increase of 0.0014 log points per week, which corresponds to approximately 0.14% faster weekly growth. Over the course of a year (52 weeks), this difference accumulates to roughly 0.073 log points, or about a 7% difference in article length.

Figure 3 illustrates these patterns using both the raw data and the model-predicted trajectories. The top panel shows the average article length for each community over time. Prior to the split, the trends for Wikitravel and Wikivoyage followed closely parallel paths, indicating that the two communities experienced near-identical growth patterns before the fork. After the split, however, the trajectories begin to diverge. Wikivoyage articles continue to increase in length at a faster rate, while the growth of Wikitravel articles slows noticeably.

The bottom panel displays the model-predicted trajectories based on the mixed-effects difference-in-differences estimates. These predictions isolate the estimated growth rates from the regression model while holding other factors constant. The predicted trajectories closely mirror the patterns observed in the raw data, with Wikivoyage exhibiting a steeper post-split growth rate than Wikitravel. Together, the raw trends and model predictions provide visual support for the regression results

reported in Table 1, showing that information accumulated more rapidly in Wikivoyage following the community split.

The second column of Table 1 (above) reports results for article polish, measured by the number of listing tags. As with article length, the coefficient for *weeks* is positive and statistically significant ($\beta = 0.01949$, $p < .001$), indicating that articles accumulated listing tags over time prior to the split. The interaction between *weeks* and the post-split indicator shows that the rate of listing tag accumulation slowed for Wikitravel after the split ($\beta = -0.01644$, $p < .001$).

The key coefficient again captures the additional post-split growth rate for Wikivoyage relative to Wikitravel. This estimate is positive and statistically significant ($\beta = 0.04221$, $p < .001$), indicating that Wikivoyage articles accumulated listing tags more rapidly after the split. Substantively, this corresponds to approximately 0.04 additional listing tags per article per week, or roughly two additional structured listings per article per year.

Figure 4 presents the corresponding patterns for article polish, measured as the number of listing tags per article. The top panel shows the raw data. Prior to the split, the two communities followed similar trajectories, with listing tags gradually increasing in both projects. After the split, however, the trends diverge. Wikivoyage articles begin to accumulate listing tags much more rapidly, while the growth in Wikitravel slows and becomes relatively flat over time.

The bottom panel shows the model-predicted trajectories derived from the mixed-effects difference-in-differences estimates. These trajectories isolate the

estimated growth rates while holding other factors constant. The predicted trends closely match the patterns observed in the raw data, with Wikivoyage exhibiting a substantially steeper post-split increase in listing tags than Wikitravel. Together, the raw trends and model predictions reinforce the regression results reported in Table 1, indicating that article polish accumulated more rapidly in Wikivoyage following the split.

Together, the raw trends and model predictions reinforce the regression results reported in Table 1, indicating that both information production and article polish increased more rapidly in Wikivoyage following the split.

Discussion

This study shows that the mix of contributors in a peer production community affects how the community develops over time. Following the split, Wikivoyage experienced a short transitional period marked by disruption rather than immediate gains, particularly in polish, as contributors adjusted to a new platform and governance structure. While both communities continued to grow overall, Wikivoyage did not show an immediate post-split acceleration. Instead, once the core group reassembled, Wikivoyage recovered and eventually grew faster than Wikitravel in both article length and polish. Wikitravel, which retained a larger periphery but lost its core, showed slower long-term growth.

These patterns suggest that core contributors do more than maintenance and polish. Peripheral contributors continued to add content on Wikitravel after the split, and the project did not collapse. However, peripheral activity alone did not lead to

accelerated growth in either information quantity or polish. Without a strong core to coordinate work, set standards, and sustain momentum, contributions from the periphery were insufficient to drive long-term increases.

These dynamics map onto long-standing debates about where value resides in collaborative systems. The first view presumes that core members contribute the most valuable work by refining and coordinating shared artifacts. Prior studies support this model, finding that core contributors are disproportionately responsible for quality control and structural integrity (Kittur et al., 2007; Crowston et al., 2006). In some cases, this work involves removing content that is redundant, low quality, or misaligned with norms. The contrasting hypothesis emphasizes that even small or infrequent contributions from peripheral members can meaningfully expand the knowledge base and drive innovation. From this combined perspective, reductions in peripheral membership would primarily constrain information growth, while losses in core membership would most directly affect polish and coherence.

In this sense, the results clarify the relationship between the Newton and Ortega hypotheses as they apply to peer production. The continued activity on Wikitravel provides limited support for the view that many small contributions can help sustain a project. At the same time, the long-term divergence in growth supports the Newton perspective: Wikivoyage's reassembled core was associated with faster improvement and greater overall growth in both information and polish. Together, these findings suggest that peripheral contributions may help maintain a project above zero, but core contributors play a central role in producing sustained growth and polish.

Building on these theoretical perspectives, I interpret shifts in contributor composition as influencing distinct dimensions of content development. Declines in core membership primarily affect polish, coordination, and structural coherence, even when overall information levels remain stable. In contrast, declines in peripheral participation constrain the addition of new material, slowing information growth while leaving polishing processes relatively intact. Framing the results this way clarifies the mechanisms underlying H1 and H2 and shows how different contributor groups shape development along separate but interrelated pathways.

These findings have important implications for understanding how peer production communities survive and grow. Many collaborative projects have a small group of highly active contributors who guide new users, maintain structure, and coordinate work. This study shows that losing these core contributors can weaken a community's ability to develop over time in ways that appear difficult to recover from. On the other hand, a large periphery may not be enough to support long-term growth on its own. In my study, the community with only a core was able to rebuild their periphery. The community with only a periphery appears to have withered.

My results suggest that platform designers and community organizers should pay close attention to the needs of core contributors. Communities may need tools or systems that help retain their most active members. This could include features that reduce repetitive tasks, share work more evenly, or create clear ways for peripheral contributors to take on larger roles.

Communities that rely on volunteer labor may benefit from investing in the stability of their core group. This might involve mentorship, clearer guidelines, or technical tools that make coordination easier. These insights also apply to other peer production settings, such as open source software, citizen science, and collaborative research projects. In each case, the balance between core and peripheral contributors affects the quality of the work and the speed of development.

Threats to Validity

This study has several limitations. First, the findings are based on a single historical event, the Wikitravel–Wikivoyage split. Because this split was unusual in its scale and circumstances, the results may not generalize to other peer production communities with different cultures, governance structures, or technical environments.

Second, my measures capture only certain types of contributor activity. Article length and structured listing tags reflect information volume and polish, but they do not capture other important forms of work, such as discussion, coordination, moderation, or conflict resolution. These activities may also play a significant role in how articles develop over time, particularly during periods of organizational change.

Third, the analysis does not track individual contributors across communities. As a result, I cannot directly observe which contributors migrated from Wikitravel to Wikivoyage or how their behavior changed after the split. This creates a potential threat to validity because observed differences between the communities may reflect changes in the composition of contributors rather than differences in how core and peripheral

participation affect knowledge production. Instead, I focus on community-level patterns, which limits my ability to make claims about individual-level dynamics.

Finally, the difference-in-differences design relies on assumptions that cannot be fully tested. Most importantly, it assumes that the treatment and comparison groups would have followed similar trends in the absence of the intervention. In this case, that assumption is unusually strong. Wikivoyage was created as a direct clone of Wikitravel using the same publicly available database dumps, and the two communities were identical in content, structure, and technical environment at the time of the split. Absent the split, there would have been only a single community following a single trajectory.

As a result, any divergence observed after the split reflects changes that occurred following the organizational separation rather than pre-existing differences between the communities. Although unobserved factors may still influence post-split dynamics, the shared content base and identical pre-split histories substantially reduce concerns about violations of the parallel trends assumption.

Conclusion

This study examined how changes in core and peripheral membership shape knowledge production in peer production communities. Using the Wikitravel–Wikivoyage split as a natural experiment, I showed that the community that retained the majority of core contributors experienced faster long-term growth in both information volume and polish. In contrast, retaining a large periphery without a strong core was not sufficient to sustain comparable growth. Although peripheral contributors

continued to participate, the absence of a coordinated core was associated with slower development and less polish over time.

These findings contribute to ongoing debates about where value is produced in collaborative systems. While peripheral participation may help maintain baseline activity, my results suggest that core contributors play a central role in sustaining long-term growth and polish. In this case, the presence of a strong core was associated with both higher rates of information accumulation and greater investment in polish.

At the same time, this study highlights important directions for future research. Further work could examine how contributors move between peripheral and core roles and how these transitions shape community outcomes. Research could also explore how governance practices and technical tools help communities retain or rebuild a core group after disruption. Comparative studies across multiple peer production communities would help clarify when a large periphery is most effective and when a strong core is especially critical. Together, these efforts can deepen our understanding of how collaborative knowledge systems survive, adapt, and grow over time.

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Appendix

Table 1. Difference-in-Differences Models for H1 & H2

Variable	Information (Log Length)	Polish (Listings)
<i>weeks</i>	0.00193*** (0.00)	0.01949*** (0.00)
<i>weeks × postsplit</i>	-0.00162*** (0.00)	-0.01644*** (0.00)
<i>weeks × wv × postsplit</i>	0.00140*** (0.00)	0.04221*** (0.00)
Observations	4,829,109	
Articles (groups)	7,464	
Notes:		
<ul style="list-style-type: none"> ● Note. Linear mixed-effects model with random intercepts for articles. ● Standard errors in parentheses. ● * $p < .05$, ** $p < .01$, *** $p < .001$. 		

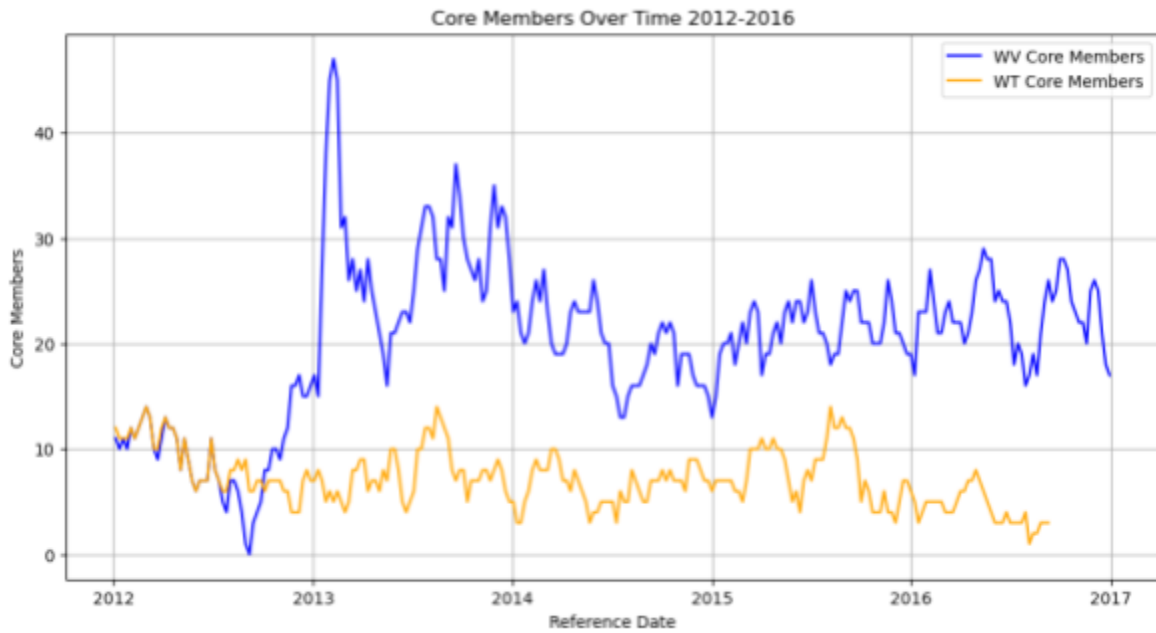
Figure 1. Core Members Over Time 2012-2016

Figure 2. Peripheral Members Over time 2012-2016

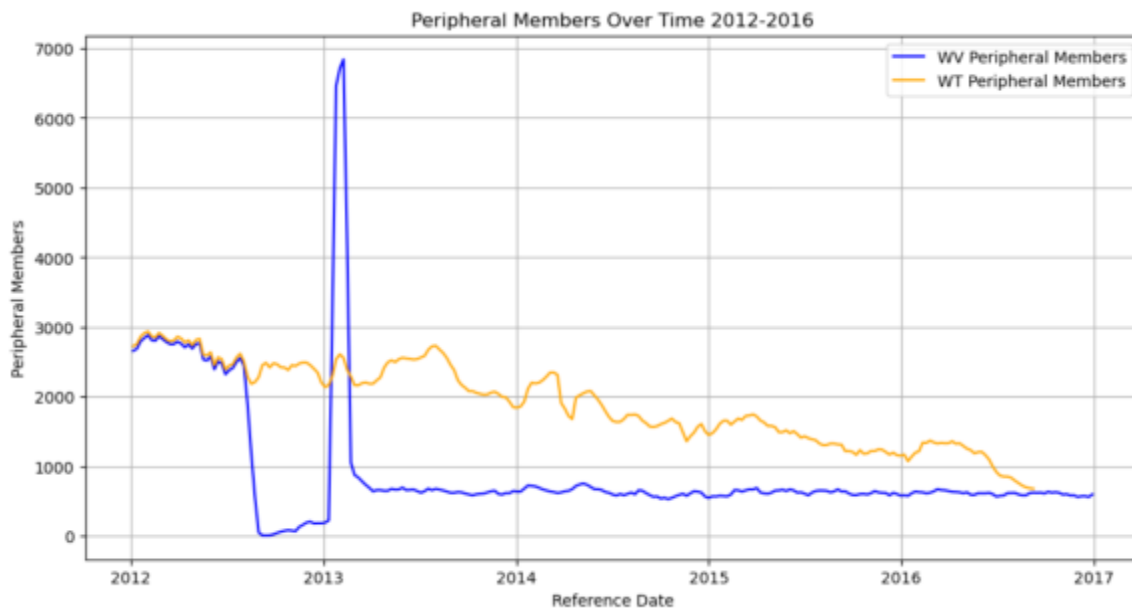


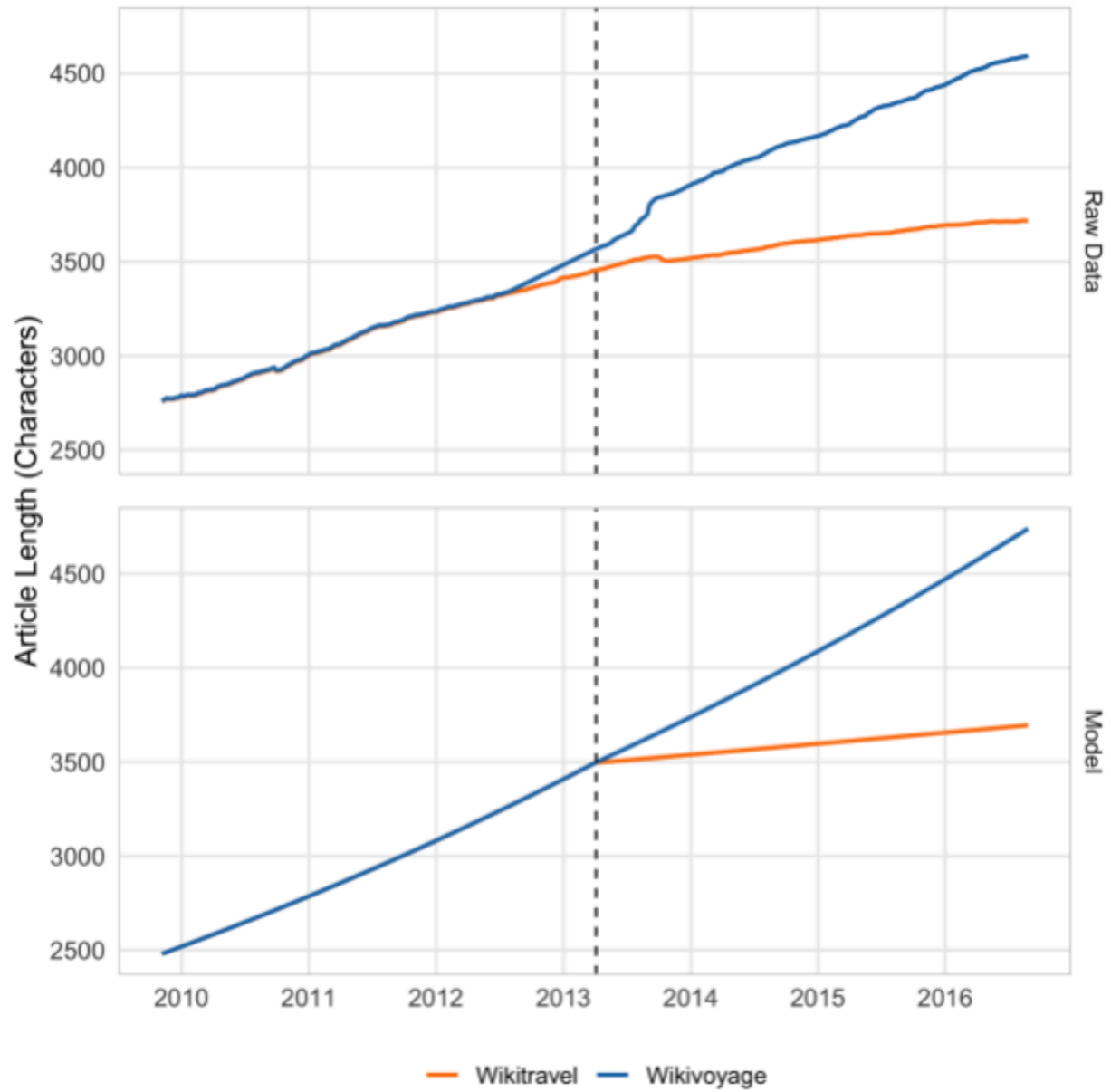
Figure 3. Raw Article Length Compared to Model Prediction 2010–2016

Figure 4. Raw Data Article Listings Compared to Model Prediction 2010–2016

